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ABSTRACT

In this document, the major outcomes of a study are reported, focusing primarily on the mathematics achievement results. The sections of Part I discuss performance on goal areas and objectives; comparisons of achievement among groups of students within each age level, 9-, 13-, and 17-year-olds; comparisons of the achievement of Connecticut students with that of students nationally; the results of each item by age, sex, region, and size of community within the state. Part II contains discussions and recommendations in the following areas: math concepts, computation, measurement, problem solving and applications, charts and graphs, and geometry. (MP)

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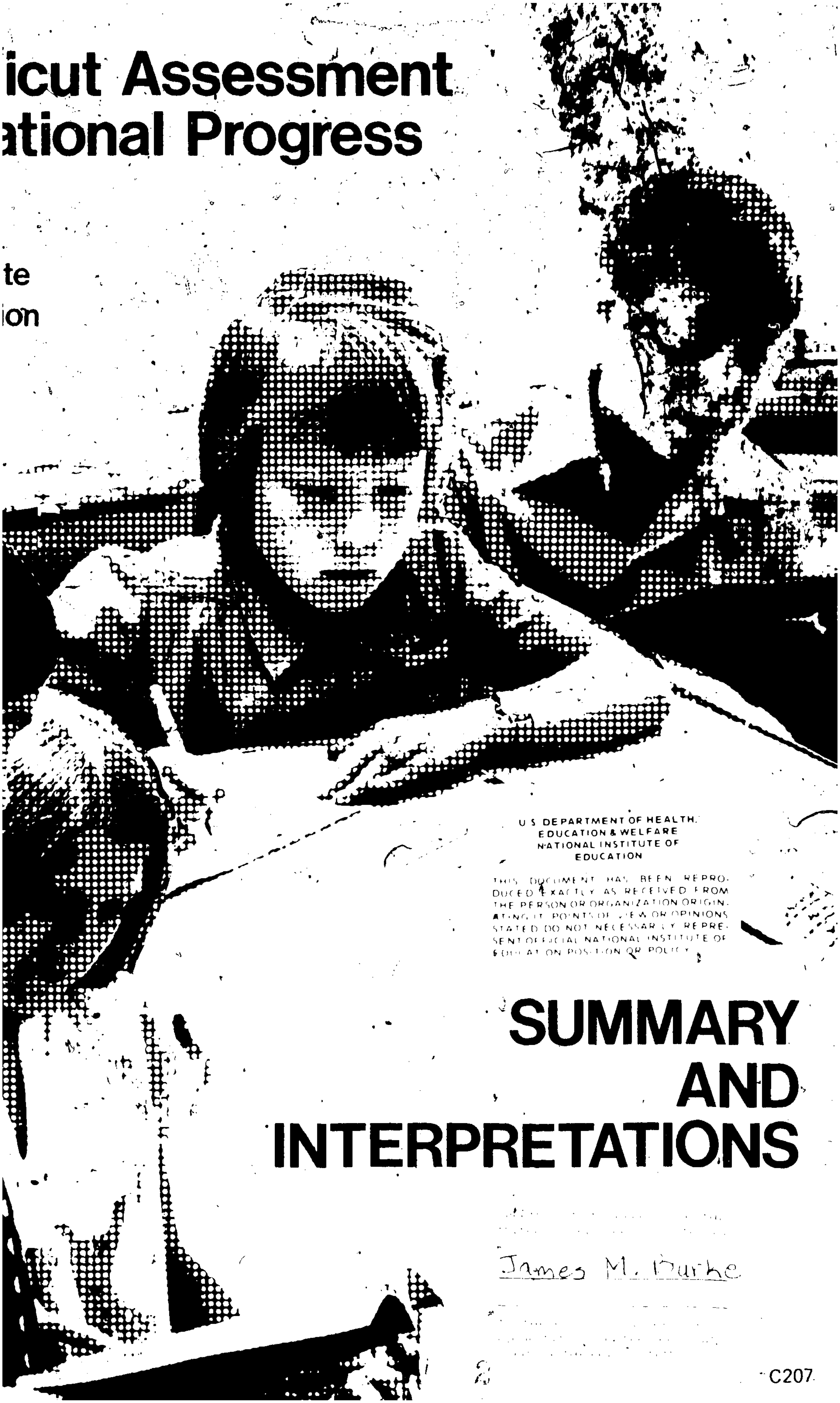



# SUMMARY AND INTERPRETATIONS

James M. Burke

C207

## CONNECTICUT STATE BOARD OF EDUCATION

STATE OF CONNECTICUT
STATE BOARD OF EDUCATION
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The Connecticut Assessment of Educational Progress conducted its fifth statewide assessment in 1976-77. The purpose of the assessment was to evaluate the knowledge, skills, and attitudes of Connecticut students in the area of mathematics. Approximately 2,000 students at each of three age levels - 9, 13, and 17 - were randomly selected from public schools in Connecticut to participate in the program. A mathematics test developed by an advisory committee of Connecticut mathematics teachers specifically for the program was administered to each of these students.

At the same time, approximately 10,000 students at each age level participated in a local assessment program, offered in conjunction with the statewide assessment. Fifty-three local school districts which elected to participate administered the same mathematics tests to their students in grades 4, 8, and 11 and received achievement results for individual students, schools, and the district as a whole. These results could be compared with those obtained statewide.

Mathematics is a skill basic to success in life in today's world. The relevance of mathematics skill to our everyday activities - as wage earners, as consumers, and as taxpayers - is apparent. Public education has the responsibility of developing this skill in students as they progress through the educational system. This assessment provides important information on how well we are meeting this responsibility.

This report describes the achievement and attitudes of Connecticut students with regard to mathematics skills considered important by Connecticut educators. Results are reported both by size of community and by region within the state, and, where possible, comparisons are made with the achievement levels of students in the nation and in the Northeast Region. Connecticut educators at both the state and local levels can use these results in making policy decisions about mathematics curriculum, instruction, and teacher education.

The Connecticut Assessment of Educational Progress in 1976-77 was sponsored by the Connecticut State Department of Education, conducted by National Evaluation Systems, Inc., and made possible by the time and effort of students, teachers, and administrators throughout the state. The cooperation of all participants is greatly appreciated.

Mark R. Shedd
Secretary
State Board of Education

MRS:gkm

Connecticut Assessment of Educational Progress
Mathematics
1976-77

SUMMARY REPORT

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*Prepared for:*

Connecticut State Board of Education
Bureau of Research, Planning and Evaluation

September, 1977

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## A DESCRIPTION OF CAEP

### Introduction

The Connecticut Assessment of Educational Progress (CAEP) is an ongoing effort to measure the success and effectiveness of educational programs in Connecticut's public schools. The 1976-77 CAEP program was an assessment of the *mathematics* knowledge, skills, and attitudes of Connecticut 9-, 13-, and 17-year-olds in grades 4, 8, and 11, respectively. This mathematics assessment marked the fifth year of CAEP, and, as in previous years, was modeled after the National Assessment of Educational Progress (NAEP) in its basic goals, design, and methodology.

The 1976-77 assessment in mathematics was conducted by National Evaluation Systems, Inc. (NES) of Amherst, Massachusetts under contract to the Connecticut State Department of Education (CSDE). The goals of the Mathematics Assessment were (1) to collect baseline data for determining student growth in mathematics knowledge in future years, (2) to collect information permitting the comparison of the present mathematics achievement of students nationally, (3) to provide achievement results useful in decision-making regarding curricula and instruction at both the state and local levels, and (4) to encourage school districts to adopt criterion-referenced assessment procedures for local planning and evaluation.

The 1976-77 CAEP program included the development and administration of three objective-referenced mathematics tests, one for each age (grade) level assessed. In designing the tests, an Advisory Committee of Connecticut Educators developed high priority mathematics objectives for students across the state and selected matching test questions for each objective. NAEP materials were used wherever appropriate. In addition, the Advisory Committee developed a student questionnaire to be administered with the tests, as well as a questionnaire for the principals of all participating schools.

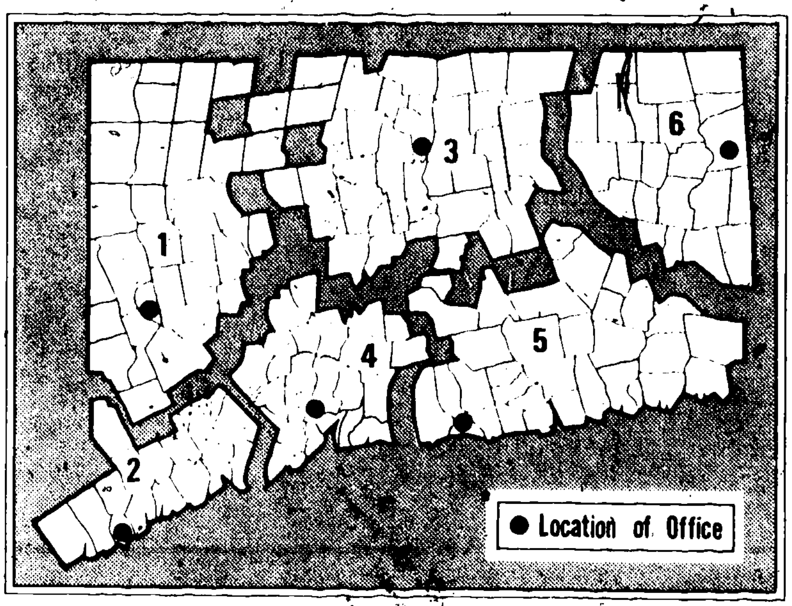
There were two primary components of the 1976-77 CAEP program: (1) Phase I: Statewide Testing and (2) Phase II: The Local Option. The latter phase constituted an opportunity for individual school districts to employ the same custom-designed tests for the purposes of local planning and evaluation. The present report describes the results of Phase I, thereby permitting those districts who participated in Phase II to compare their achievement results with statewide results.

## Sampling Design

In order to provide information about the mathematics performance of students throughout Connecticut in a cost-effective manner, a sample of students at each age (grade) level was tested. The sampling procedure protected the anonymity of all students, schools, and school districts participating in the assessment. In all, a total of 2,437 9-year-olds (fourth-graders) 2,745 13-year-olds (eighth-graders), and 2,362 17-year-olds (eleventh-graders) were tested. One hundred fifteen schools were involved in the fourth-grade testing, 109 schools at the eighth-grade level, and 90 schools at the eleventh-grade level. In all, approximately 110 districts were involved in statewide testing.

The sample at each age (grade) level contained students from schools in each of the six Connecticut Educational regions and from schools in four sizes of community. The map below shows the division of the state into regions. Each region is identified in the key below the map.

**CONNECTICUT REGIONAL EDUCATIONAL SERVICE CENTERS**




Region 1: Regional Educational Services Concepts (through) Unified Effort (RESCUE)
Region 2: Cooperative Educational Services
Region 3: Capital Region Educational Council (CREC)
Region 4: Area Cooperative Educational Services (ACES)
Region 5: Project Learn
Region 6: Northeast Area Regional Special Educational Services (N.A.R.S.E.S.)

The sizes of community (SOC) were defined as follows:

| | |
|---|---|
| SOC 1 "Big Cities" | = towns of more than 100,000 population |
| SOC 2 "Fringe Cities" | = towns whose borders are contiguous with Big Cities and whose populations exceed 10,000 |
| SOC 3 "Medium Cities" | = towns of more than 25,000 population which are not Big Cities or Fringe Cities |
| SOC 4 "Smaller Places" | = all other towns |

## The Tests

Three criterion-referenced tests, one for each age (grade) level, were developed by the Advisory Committee. Criterion-referenced tests are based on achievement with regard to specific objectives: a student's score reflects achievement relative to a definite task rather than normative performance. The tests were developed on the basis of the following guidelines:

- The domains assessed should focus on basic mathematics concepts, computational skills, basic concepts of measurement and geometry, and practical application of these skills in problem solving situations.
- All objectives at each age level should meet the criterion of mastery of content that is within the experience of *all* children at that level.
- In no way should the objectives to be tested attempt to represent *all* the skills and concepts being taught at each level.

A list of the 12 objectives for 9-year-olds and the 16 objectives for 13- and 17-year-olds is presented in Table 1 categorized by goal area. There were 60 test items on the 9-year-old test, 66 on the 13-year-old test, and 64 on the 17-year-old test. There were five items for each objective for 9-year-olds and approximately four items for each objective for 13- and 17-year-olds.

While some test items were administered to more than one age group, other items varied in difficulty according to age level. The reader should bear in mind that, while in some cases a given objective was used for two different age levels, some test items matched to the objective differed for the two age levels.

The achievement of each age (grade) level on objectives, goal areas, and individual test items is described later in this report.

TABLE 1

Objectives Assessed at Each Level

| Goal Area | Objective | | |
|---|---|---|---|
| | 9-Year-Olds | 13-Year-Olds | 17-Year-Olds |
| MATHEMATICAL CONCEPTS | The student demonstrates an understanding of: | | |
| | 1. place value for whole numbers.<br>2. ordering of whole numbers.<br>3. fractional notation. | 1. rational numbers in the form of fractions and decimals.<br>2. ordering of decimals, fractions, and whole numbers. | 1. rational numbers in the form of fractions and decimals.<br>2. ordering of decimals, fractions, and whole numbers. |
| COMPUTATION | The student demonstrates the ability to: | | |
| | 4. add whole numbers.<br>5. subtract whole numbers.<br>6. multiply whole numbers. | 3. add and subtract whole numbers.<br>4. multiply whole numbers.<br>5. divide whole numbers.<br>6. add and subtract decimals.<br>7. multiply decimals.<br>8. add and subtract fractions and mixed numbers.<br>9. multiply fractions and mixed numbers. | 3. add and subtract whole numbers.<br>4. multiply whole numbers.<br>5. divide whole numbers.<br>6. add and subtract decimals.<br>7. multiply and divide decimals.<br>8. add and subtract fractions and mixed numbers.<br>9. multiply and divide fractions and mixed numbers. |

TABLE 1 (continued)

| Goal Area | Objective | | |
| --- | --- | --- | --- |
| | 9-Year-Olds | 13-Year-Olds | 17-Year-Olds |
| MEASUREMENT | The student demonstrates: | | |
| | 7. the ability to convert U.S. units of currency to larger or smaller units.<br>8. the ability to identify and compute time from a clock face.<br>9. a working knowledge of linear units of measure. | 10. a working knowledge of area and perimeter<br>11. the ability to convert a U.S. unit of measure to larger or smaller units.<br>12. knowledge of metric units of measure. | 10. a working knowledge of area, perimeter, and volume.<br>11. the ability to convert a U.S. unit of measure to larger or smaller units.<br>12. knowledge of metric units of measure. |
| CHARTS AND GRAPHS | The student demonstrates the ability to: | | |
| | 12. interpret data from charts and graphs. | 13. interpret data from charts and graphs. | 13. interpret data from charts and graphs. |

TABLE 1 (continued)

| Goal Area | Objective | | |
|---|---|---|---|
| | 9-Year-Olds | 13-Year-Olds | 17-Year-Olds |
| APPLICATIONS/ PROBLEM SOLVING | The student demonstrates the ability to: | | |
| | 10. solve word problems involving mathematical skills.<br>11. solve word problems involving real world situations. | 14. solve word problems involving mathematical skills.<br>15. solve word problems involving real world situations. | 14. solve word problems involving mathematical skills.<br>15. solve word problems involving real world situations. |
| GEOMETRY | The student demonstrates: | | |
| | | 16. knowledge of basic geometric concepts. | 16. the ability to solve problems involving basic geometric concepts. |

## Student and Principal Questionnaires

The purpose of developing student and principal questionnaires was two-fold: (1) to identify characteristics of students and their schools that might prove to bear a relationship to mathematics achievement, and (2) to provide a general characterization of students and schools that, in itself, might prove useful in policy decisions. Highlights of outcomes related to these purposes are presented later in this report.

## Test Administration

To limit the burden placed on school personnel, all test sessions were conducted by test administrators trained by NES. Testing sessions, lasting between 45 and 60 minutes, included the administration of the student questionnaire and the test for the respective age (grade) level.

All data collection occurred during October-November, 1976 for 9-year-olds (fourth-graders), during February, 1977 for 13-year-olds (eighth-graders), and during April, 1977 for 17-year-olds (eleventh-graders).

Workshops on test administration procedures were provided for district personnel who were participating in Phase II in order to ensure standardized and valid testing sessions.

## Reporting the Results

Part I of this report describes the major outcomes of the assessment focusing primarily on the mathematics achievement results. The sections of Part I discuss:

- performance on goal areas and objectives
- comparisons of achievement among groups of students within each age (grade) level

The interested reader may contact the Bureau of Research, Planning and Evaluation at the Connecticut State Department of Education for more in-depth information about the methodology and outcomes of CAEP.

## Interpretations and Recommendations

Part II of this report represents the interpretations of the Mathematics Advisory Committee based on the results of the assessment. Their interpretations of these results are presented here along with their recommendations with regard to mathematics education within the state of Connecticut. Their recommendations should prove interesting and valuable to those people—legislators, school superintendents, classroom teachers, and laypersons—concerned with providing quality mathematics education.

PART I

SUMMARY OF RESULTS

# CHAPTER 1

# CONNECTICUT RESULTS BY GOAL AREA AND OBJECTIVE

## Introduction

In order to describe the achievement of Connecticut 9-, 13-, and 17-year-olds, CAEP results include performance on each test item, each objective, and each goal area. In this section, results by goal area and objective are described for each age level in both graphic and narrative form.

Figure 1 displays the average percentage of matching test items answered correctly in each goal area by each age group. Figures 2 through 4 present parallel data by objective for each respective age group. If, for example, students at a given age level show an average of 72% for a particular goal or objective, this means that, on the average, these students answered correctly 72% of the matching test items. The reader is reminded, when comparing performance across age groups on a similar goal or objective, that the group of matching test items *differed* for each age group. The full text of each objective may be found in Table 1 (pp. xii to xiv).

## Summary of Results

*GOAL AREA ACHIEVEMENT.* Nine-year-olds scored quite highly on four of the five goal areas, answering correctly an average of over 74% of the matching test items in the goal areas of Concepts, Computation, Measurement, and Charts and Graphs. Lowest performance by 9-year-olds was in the goal area of Problem Solving (54.5% correct).

Performance of 13-year-olds was more variable across the objectives. Their achievement ranged from a high of 89.1% correct on Charts and Graphs to a low of 61.2% on Mathematical Concepts.

The widest range in achievement across goal areas was displayed by 17-year-olds who scored above 90% on one goal area (Charts and Graphs), just above 80% on two goal areas (Computation and Measurement), 66-68% on two other goal areas (Concepts and Problem Solving), and as low as 48% on Geometry.

*ACHIEVEMENT ON OBJECTIVES.* Nine-year-olds scored an average of over 80% correct on four of the 12 objectives assessed at that age level (Adding

FIGURE 1

Graph of Achievement on Goal Areas by Age Group

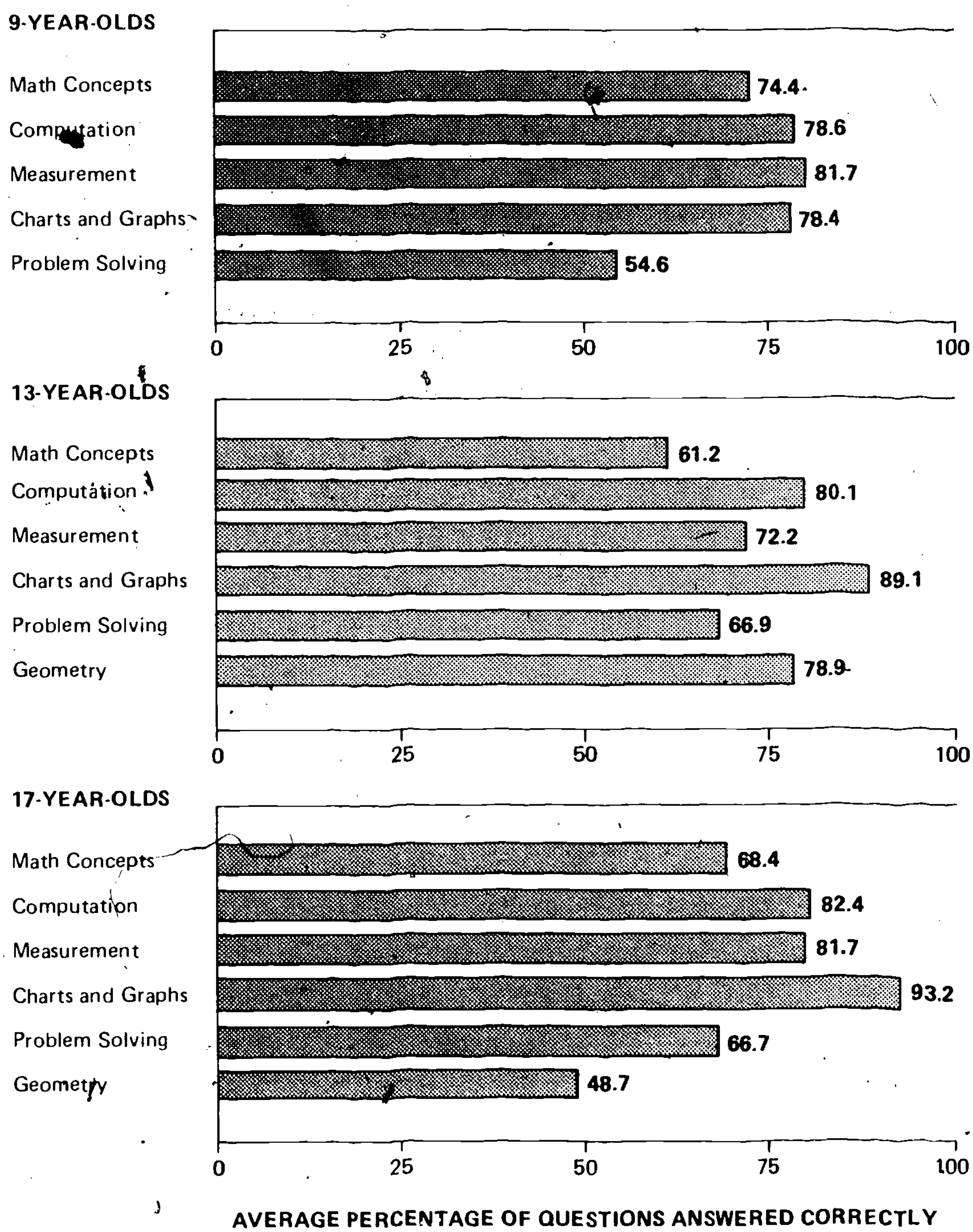


FIGURE 2

Graph of Achievement on Objectives: 9-Year-Olds

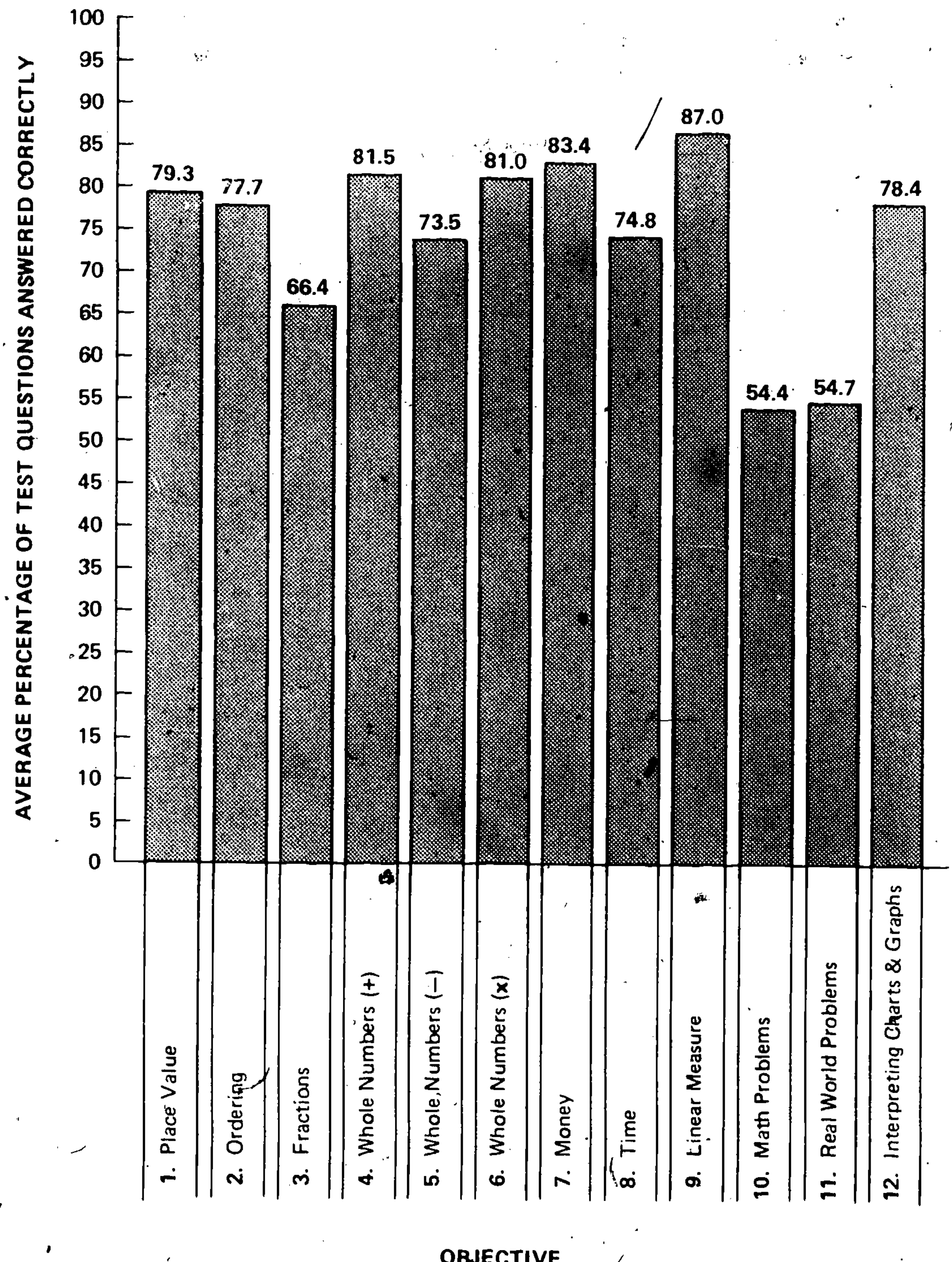


FIGURE 3

Graph of Achievement on Objectives: 13-Year-Olds

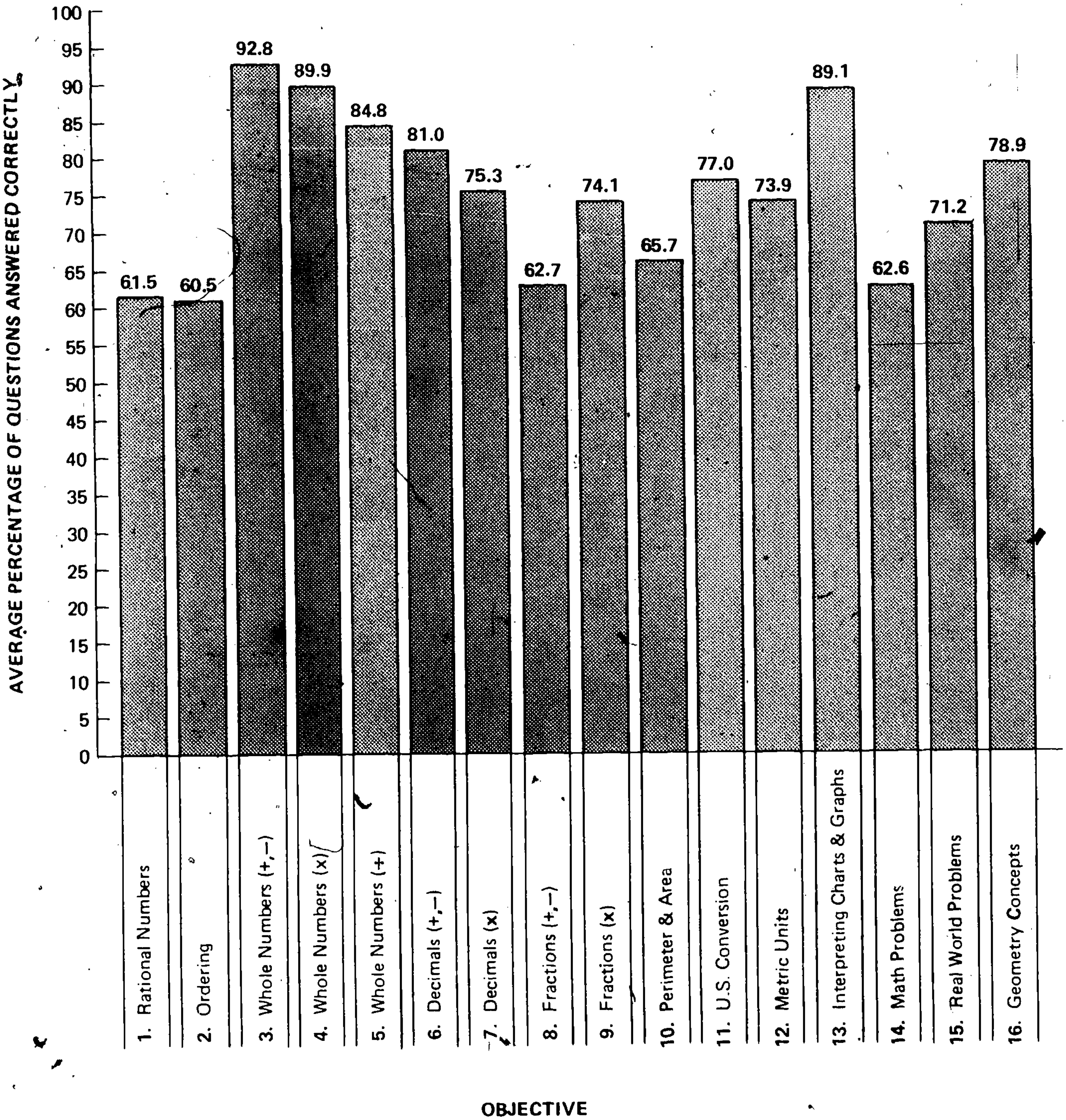
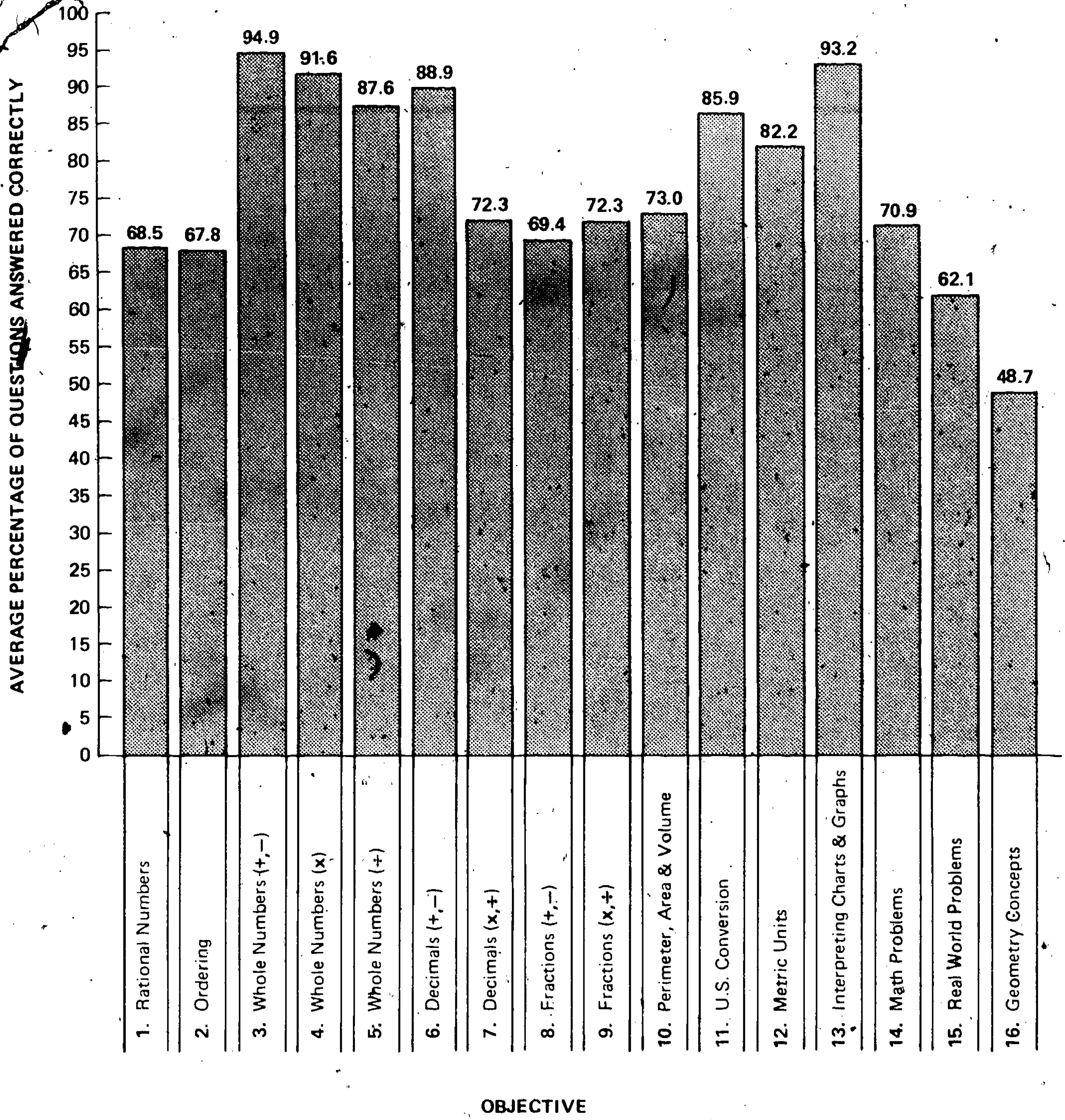


FIGURE 4

Graph of Achievement on Objectives: 17-Year-Olds



Whole Numbers, Multiplying Whole Numbers, Money, and Linear Problems). Their lowest performance was on Math Problems and Real World Problems (both 54% correct) and Understanding Fractions (66%). On all other objectives, 9-year-olds scored in the 73-79% range.

Thirteen-year-olds scored an average of around 90% correct on three of the 16 objectives assessed at their level (Multiplying Whole Numbers, Adding and Subtracting Whole Numbers, and Interpreting Charts and Graphs). On five other objectives, performance was in the 60-65% range (Rational Numbers, Ordering, Adding and Subtracting Fractions, Area and Perimeter, and Math Problems). On the remaining eight objectives, 13-year-olds scored in the 71-85% range.

Seventeen-year-olds performed most highly on the same three objectives on which 13-year-old achievement was highest: Adding and Subtracting Whole Numbers (95%), Multiplying Whole Numbers (91%), and Interpreting Charts and Graphs (93%). By contrast, however, 17-year-olds' performance was lowest on the Geometry Concepts objective (about 49%). These students scored in the 82-89% range on four other objectives (Dividing Whole Numbers, Adding and Subtracting Decimals, U.S. Conversions, and Metric exercises). They scored in the 62-73% range on the remaining eight objectives.

The 17-year-olds performed better than the 13-year-olds, and the 13-year-olds performed better than the 9-year-olds on items which were identical for each pair of age groups. Generally, the difference between the performance of 9- and 13-year-olds was greater than the difference between the performance of 13- and 17-year-olds.

# CHAPTER 2

## COMPARING TOTAL TEST ACHIEVEMENT BY CONNECTICUT REPORTING GROUPS

### Introduction

The purpose of this section is to describe and compare the mathematics achievement of selected groups of students within Connecticut. Most of the selected groups are defined on the basis of responses to the student questionnaires. A total of 10 questions from the student questionnaires are used to define reporting groups, although some of these questions were not administered to all three age groups. Two other variables (region and size of community) are also reported.

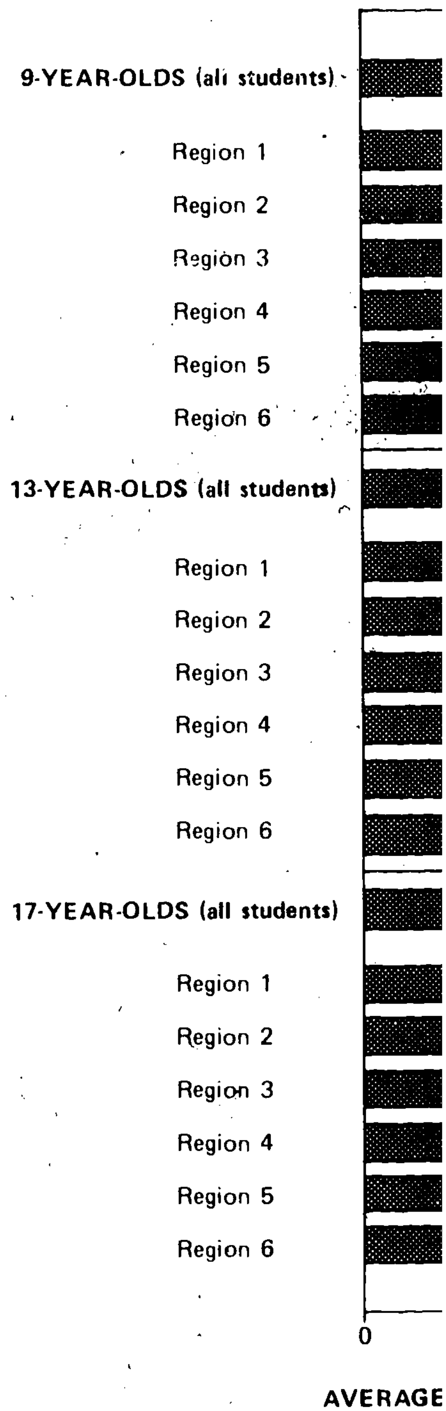
The average percentage of test items answered correctly was computed for each student group. In each case the average for the reporting group is compared to that for *all* students at that age level within Connecticut (the state average). The purpose of these analyses was to identify those factors that bear a relationship to student achievement. This section provides a summary overview of the results comparing Connecticut reporting groups. Achievement is defined as performance on the total test; that is, the average percentage of all items on the test answered correctly by students in a given group.

Differences described are those that were statistically significant at the .05 level of confidence. The reader is cautioned to refrain from drawing cause-effect inferences from these data. The differences observed suggest only a *relationship* between a given factor and achievement, *not a causative influence* of the factor on achievement.

Further, the reader should note that statistical significance is not to be equated with educational meaningfulness. Small differences between groups may be *statistically significant*; however, they may be too small to be educationally meaningful. The reader is directed to consider the magnitude of the differences in scores between groups to determine educational meaningfulness.

Figures 5 and 6 display the results by region and size of community, respectively. Table 2 displays the results for each reporting group at each age level based on student questionnaire responses. A narrative summary of the results follows.

Graph of Achie

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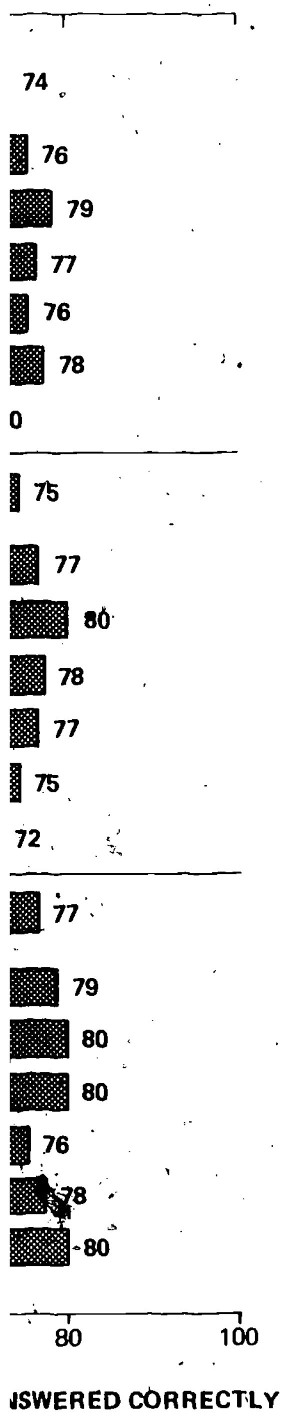

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FIGURE 6

Graph of Achievement on Total Test by Size of Community

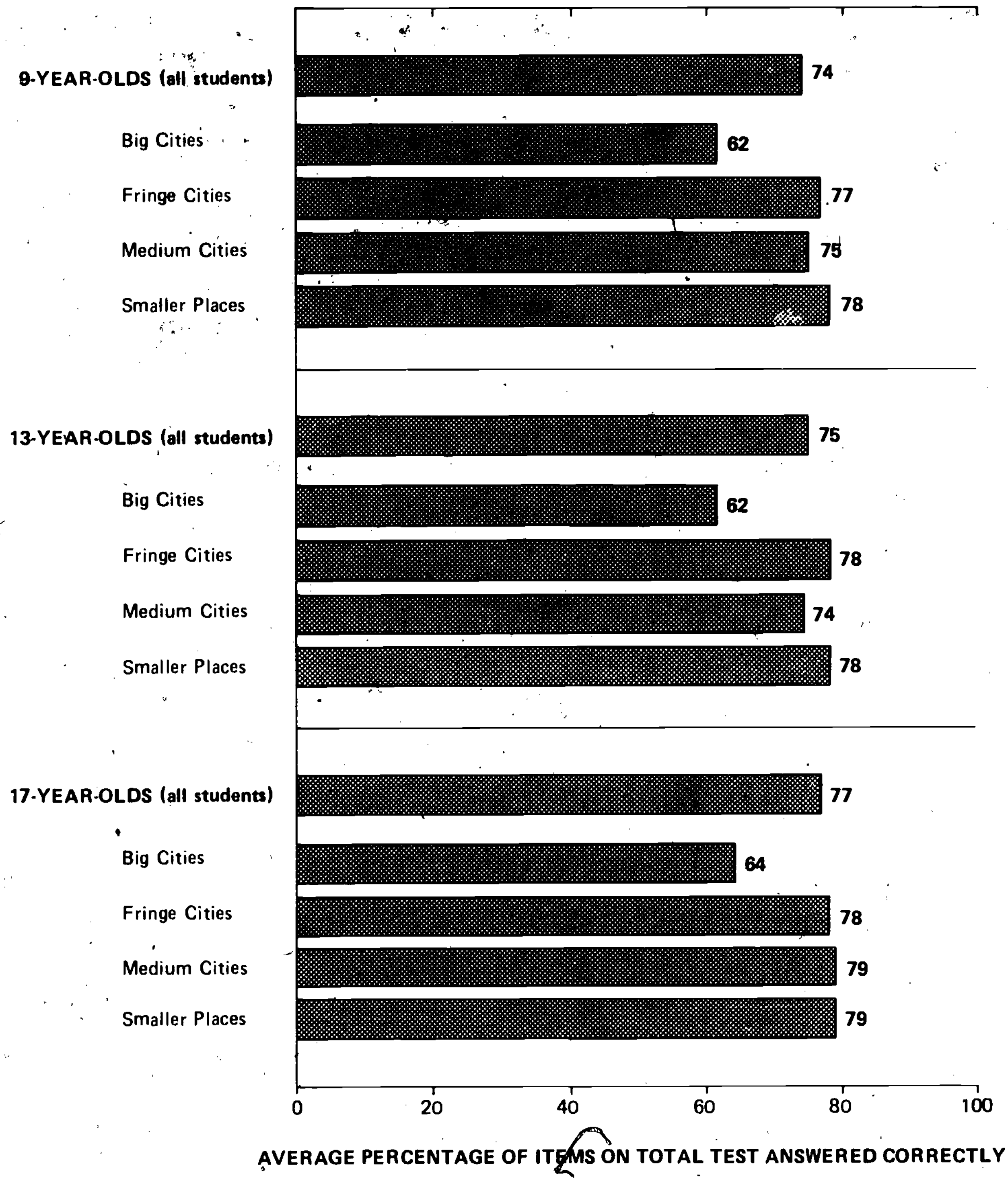


TABLE 2

Achievement of Connecticut Reporting Groups

| Reporting Groups | Average Percentage of Items on Total Test Answered Correctly | | |
|---|---|---|---|
| | 9-Year-Olds | 13-Year-Olds | 17-Year-Olds |
| *ALL STUDENTS* | *74* | *75* | *77* |
| Sex of Student | | | |
| Male | 75 | 77 | 80 |
| Female | 74 | 73 | 75 |
| Considering Grades 9, 10, and 11, How Many Years Have You Had Math? | | | |
| None | | | 54 |
| 1 Year | | | 60 |
| 2 Years | | | 69 |
| 3 Years | | | 81 |
| Math Useful Outside of School | | | |
| Not Very Useful | | | 77 |
| Somewhat Useful | | | 78 |
| Very Useful | | | 74 |
| You and Parents Talk about School | | | |
| Hardly Ever | 69 | 70 | |
| Monthly | 75 | 72 | |
| Weekly | 78 | 75 | |
| Daily | 74 | 76 | |
| Encouragement from Parents—Schoolwork | | | |
| Hardly Any | | 74 | 73 |
| Only a Little | | 72 | 76 |
| Quite a Bit | | 75 | 77 |
| A Lot | | 76 | 78 |

TABLE 2 (continued)

| Reporting Groups | Average Percentage of Items on Total Test Answered Correctly | | |
|---|---|---|---|
| | 9-Year-Olds | 13-Year-Olds | 17-Year-Olds |
| **Do You Like Your School?** | | | |
| I Hate It | 70 | 72 | 72 |
| I Don't Like It | 74 | 73 | 75 |
| It's O.K. | 75 | 74 | 75 |
| I Like It | 79 | 78 | 80 |
| I Like It a Lot | 72 | 76 | 79 |
| **Level of Schooling You Would Like** | | | |
| Not Finish High School | | | 69 |
| Graduate High School | | | 65 |
| Vocational School | | | 70 |
| 2-Year College | | | 73 |
| 4-Year College | | | 82 |
| Graduate School | | | 87 |
| **How Many Hours per Day Watching Television?** | | | |
| Less Than 1 Hour | 68 | 79 | 81 |
| Between 1 and 2 Hours | 77 | 78 | 79 |
| Between 2 and 3 Hours | 79 | 77 | 77 |
| Between 3 and 4 Hours | 76 | 75 | 74 |
| More Than 4 Hours | 72 | 70 | 67 |
| **How Much Do You Like Math?** | | | |
| Not at All | 70 | 71 | 71 |
| Somewhat | 76 | 74 | 77 |
| Very Much | 74 | 77 | 83 |
| **Math Useful Compared to Other Subjects** | | | |
| Not Very Useful | 67 | 70 | 71 |
| Somewhat Useful | 76 | 73 | 76 |
| Very Useful | 74 | 76 | 80 |

Summary of Results

- *REGION OF THE STATE:* Region 2 students and Region 3 students of all age levels performed above the state, with Region 3 below Region 2 at each age level. In addition, Region 5 9-year-olds, Region 4 13-year-olds, and Region 1 17-year-olds performed above the state. The reader is reminded that "Big Cities" are *not included in* their respective regions.

- *SIZE OF COMMUNITY:* Big city students at each age level performed well below the state. Medium city 9- and 13-year-olds performed the same as the state, although these 17-year-olds performed above the state. Fringe city and smaller community students at each age level exceeded the state, with smaller communities above fringe cities at each age level.

- *SEX OF STUDENT:* Nine-year-old males and females performed the same as the state, whereas 13- and 17-year-old males performed above and 13- and 17-year-old females performed below the state, with the magnitude of the differences increasing at the upper age level.

- *TALKING WITH PARENTS:* Higher performance tended to be displayed by 9- and 13-year-old students who reported more frequent discussion of school with parents. This trend was slightly more pronounced among 9-year-olds. (This variable was not assessed for 17-year-olds.) Roughly 80% of 9- and 13-year-olds reported that they have at least weekly discussions with their parents about school.

- *PARENTAL ENCOURAGEMENT:* Higher performance tended to be displayed by 13- and 17-year-olds who reported higher degrees of parental encouragement of schoolwork. This trend was more pronounced among 13-year-olds. (This variable was not assessed for 9-year-olds.) At least three-quarters of 13- and 17-year-olds claimed to receive "quite a bit" or "a lot" of parental encouragement about school.

- *ATTITUDE TOWARD SCHOOL:* There was a general trend at each age level for performance relative to the state to improve as the student's reported attitude toward school became more positive. A plurality of students at each age level think school is "okay," but a larger percentage of 9-year-olds (35%) than 13- or 17-year-olds (11%) like school "a lot."

- *TELEVISION WATCHING:* At the 9-year-old level, performance relative to the state improved, then declined, as the reported amount of time watching television increased. In contrast, at the 13- and 17-year-old levels, performance steadily declined as time watching television increased, with this trend somewhat more pronounced at the 17-year-old level. Amount of television watching declines with age; over four hours per day was reported by about 40% of 9-year-olds, 25% of 13-year-olds, and 10% of 17-year-olds.

- *ATTITUDE TOWARD MATH:* There was a general trend at each age level for performance relative to the state to improve as the student's reported attitude toward mathematics became more positive, with this trend most pronounced at the 17-year-old level. The appeal of mathematics declines with age; about half of all 9-year-olds, 30% of all 13-year-olds, and 20% of all 17-year-olds reported liking math "very much."

- *COMPARATIVE USEFULNESS OF MATH:* There was a fairly strong tendency at each level for performance to improve as the student's perception of the utility of mathematics compared to other subjects studied became more positive. The perceived usefulness of mathematics in comparison to other subjects declines with age, although very few students at any age level find it of "minimal" use. Statewide, about two-thirds of 9-year-olds, half of the 13-year-olds, and a third of the 17-year-olds find math relatively "very useful."

- *USEFULNESS OF MATH OUTSIDE SCHOOL:* Seventeen-year-olds who reported finding mathematics "very useful" outside of school scored somewhat *below* the state, those who find it "somewhat useful" scored slightly *above* the state, and those who find it "not very useful" scored the same as the state. (This variable was not assessed at the 9- and 13-year-old levels.) Approximately 70% of 17-year-olds statewide find mathematics "somewhat" useful outside of school, and another 20% find it "very useful."

- *YEARS OF MATH INSTRUCTION:* At the 17-year-old level, there was a very strong tendency for performance to improve as reported years of mathematics instruction increased. (This variable was not assessed at the 9- and 13-year-old levels.) Almost 70% of 17-year-olds statewide have had three years of high school mathematics, almost a quarter have had two years, and only 7% have had only one year.

- *SCHOOL ASPIRATIONS:* There was a strong tendency for performance to improve as educational ambitions increased. Those students whose aspirations did not exceed a two-year college scored below the state, while those students who aspired to a four-year college or beyond scored above the state. (This variable was not assessed at the 9- and 13-year-old levels.) Virtually all 17-year-olds plan to finish high school, and only about 13% plan only to finish high school. Fringe city students have the highest aspirations, with about 60% (as compared with 54% statewide) planning on four or more years of college.

# CHAPTER 3

# COMPARING CONNECTICUT WITH THE NATION AND THE NORTHEAST REGION

## Introduction

In order to put into perspective the achievement of Connecticut students, results presented here compare Connecticut students with students in the nation and the Northeast region tested by the National Assessment of Educational Progress (NAEP). While many items on the tests were originally NAEP items, a number of them were modified for the CAEP tests. The results described here are for items that were *exactly* the same on both the NAEP and CAEP tests.

Figures 7, 8, and 9 show the average percentage of these test items answered correctly in each goal area by students in Connecticut, the nation, and the Northeast at the three respective age levels. Figure 10 shows the percentage of those NAEP items on which each Connecticut age group scored higher, lower, and not significantly different than the nation and the Northeast. The Northeast region is defined by NAEP as including Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Washington D.C., Pennsylvania, and Maryland.

The reader should bear in mind that NAEP tests students at each age level regardless of the grade in which they are enrolled, while CAEP tested 9-, 13-, and 17-year-olds enrolled only in grades 4, 8, and 11, respectively. Further, NAEP uses paced audiotapes to accompany the tests, while CAEP did not. These differences should be taken into consideration when interpreting the comparisons.

## Summary of Results

There were a total of 14 items for 9-year-olds, 20 for 13-year-olds, and 23 for 17-year-olds that were identical on both the NAEP and CAEP tests.

*COMPARISONS WITH THE NATION*. On *none* of these test items did Connecticut 9-year-olds score significantly lower than their national counterparts. Both Connecticut 13- and 17-year-olds performed significantly lower on only two items relative to students nationally.

FIGURE 7

Comparing Connecticut, the Nation and the Northeast by Goal Area.

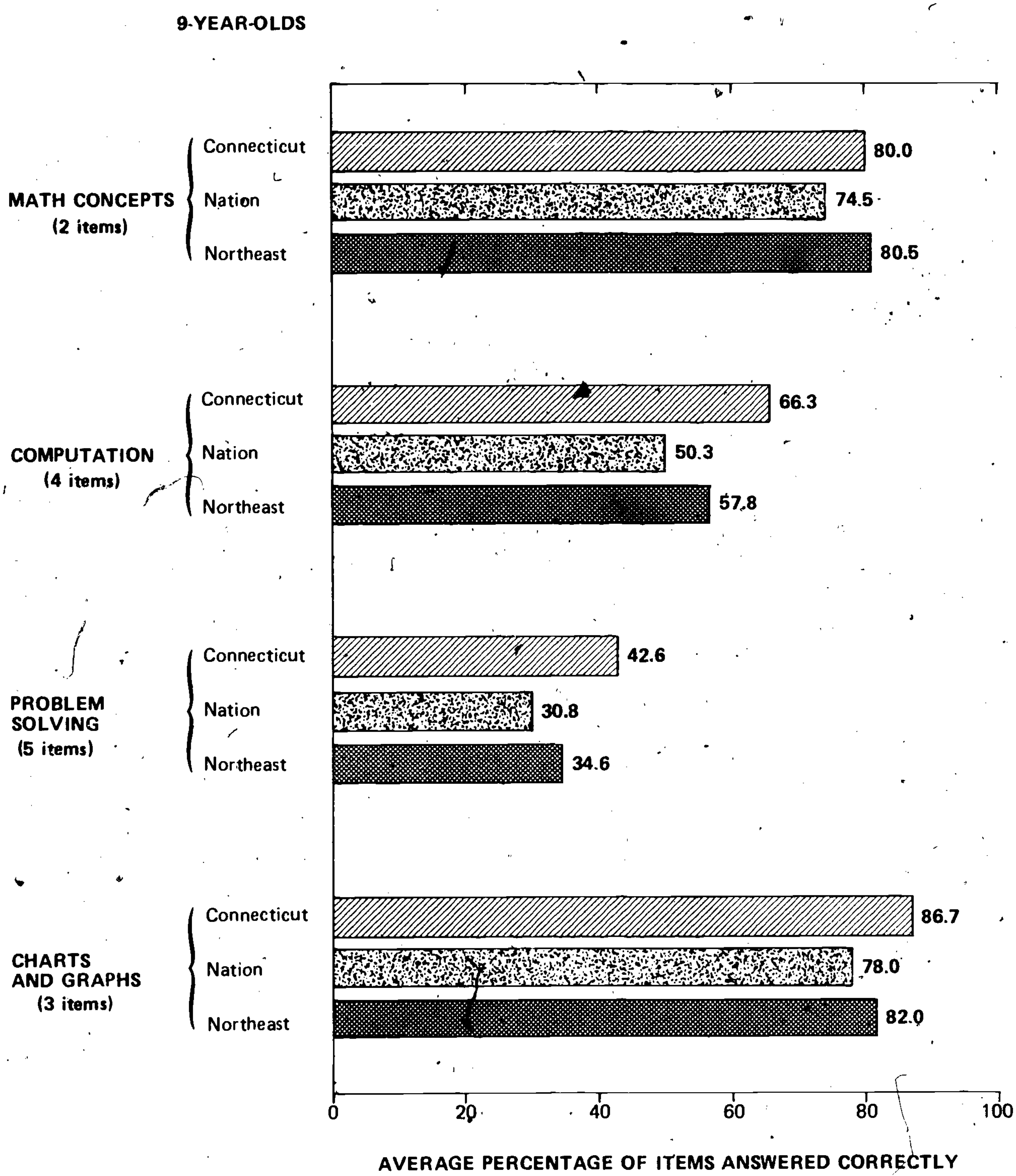


FIGURE 8

Comparing Connecticut, the Nation and the Northeast by Goal Area

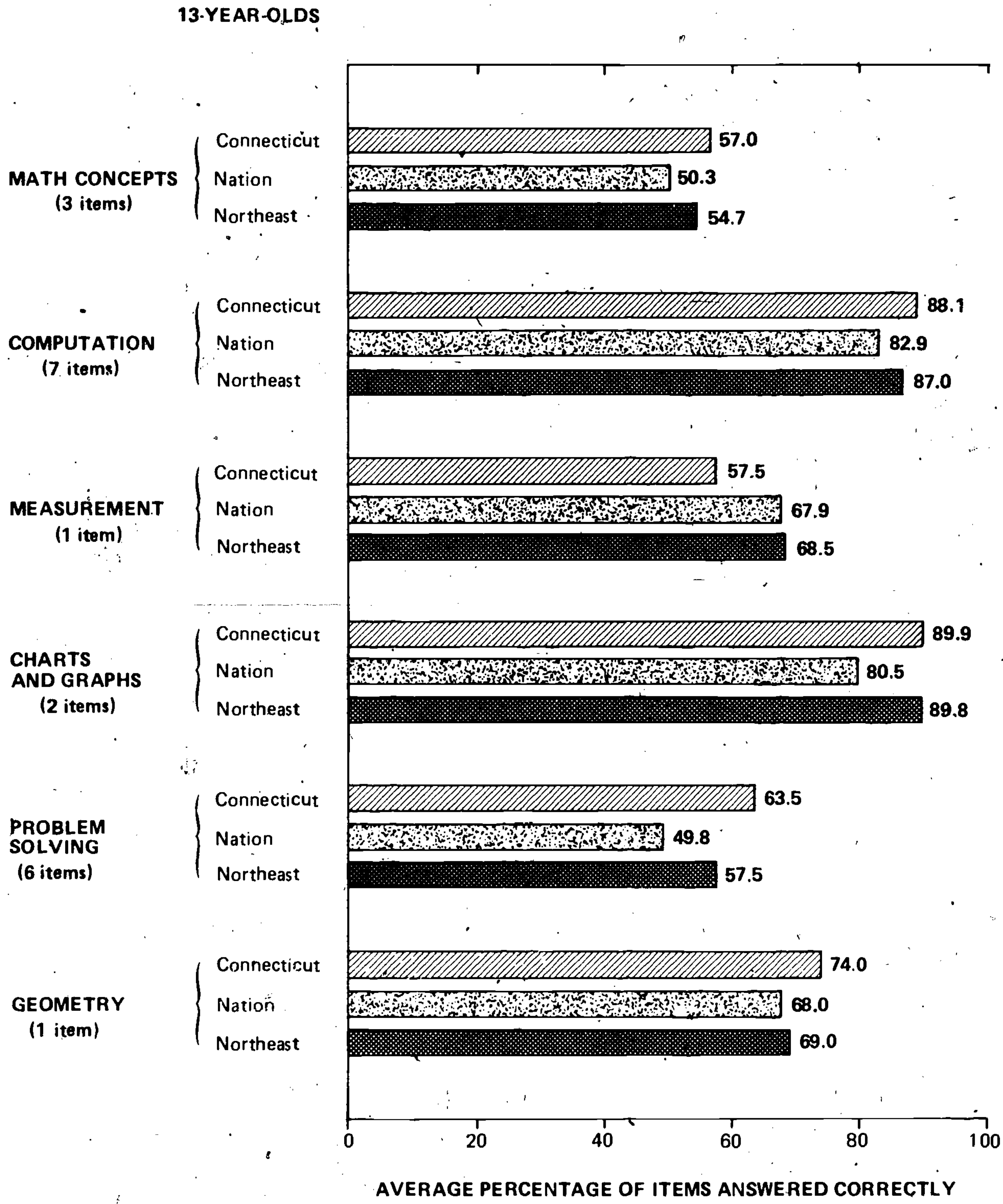
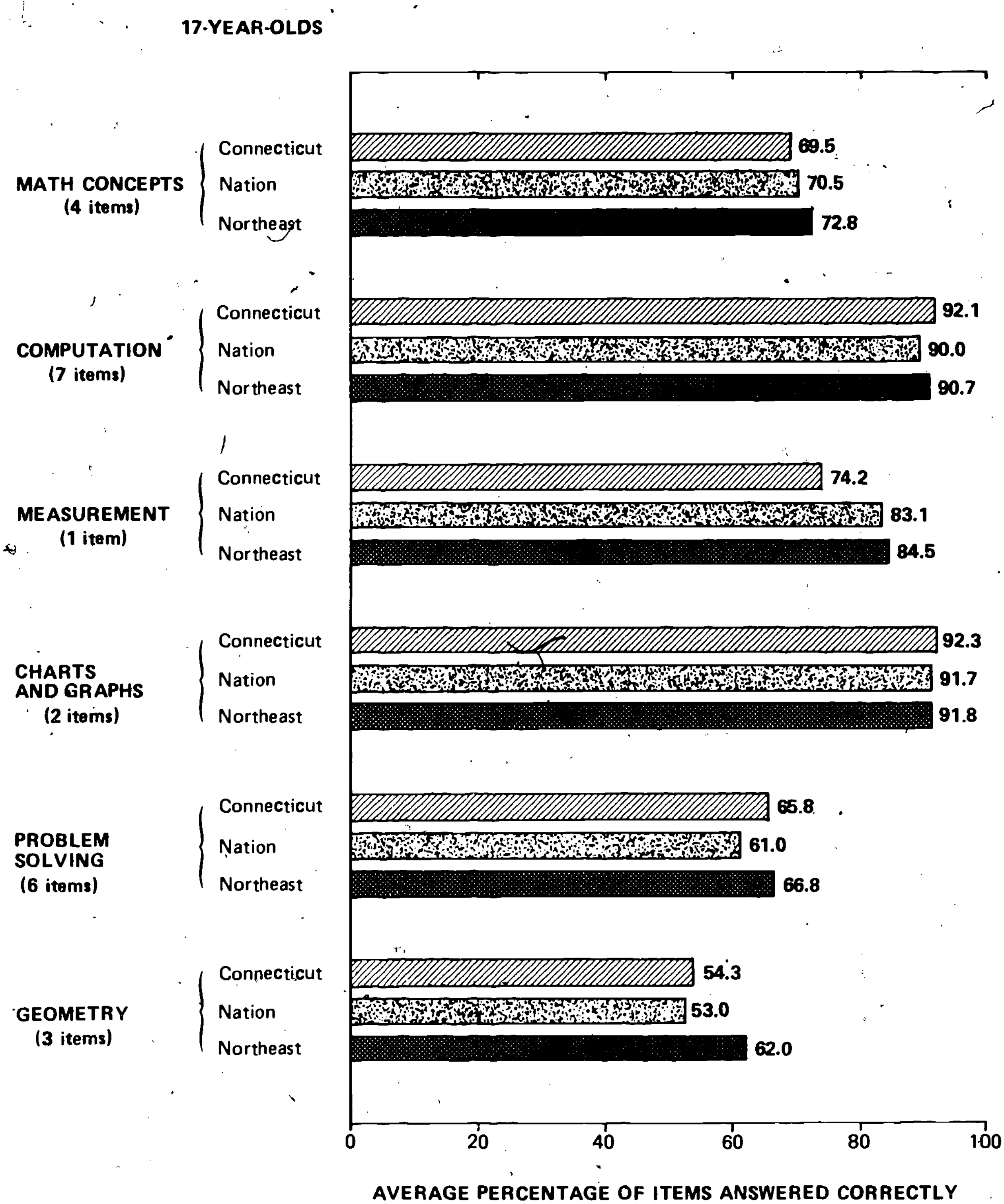


FIGURE 9

Comparing Connecticut, the Nation and the Northeast by Goal Area



Comparing Connecti

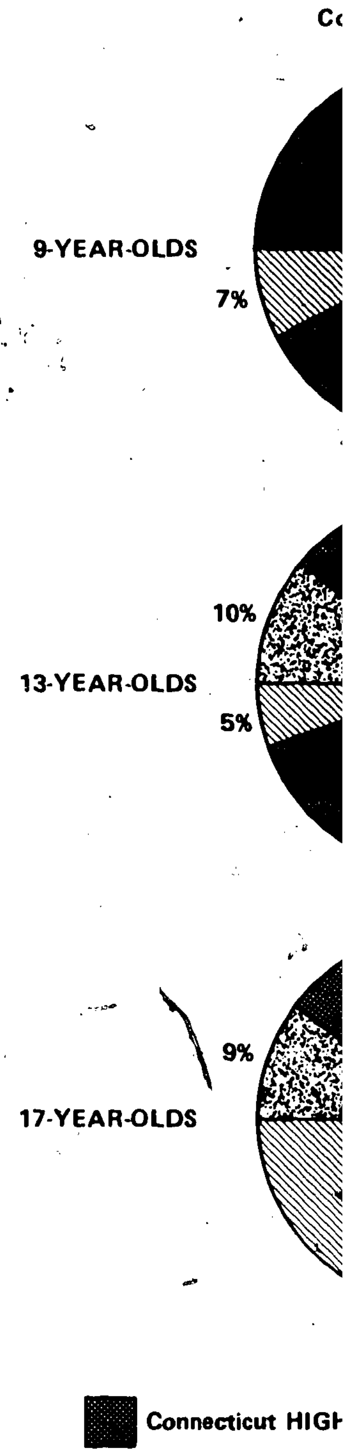
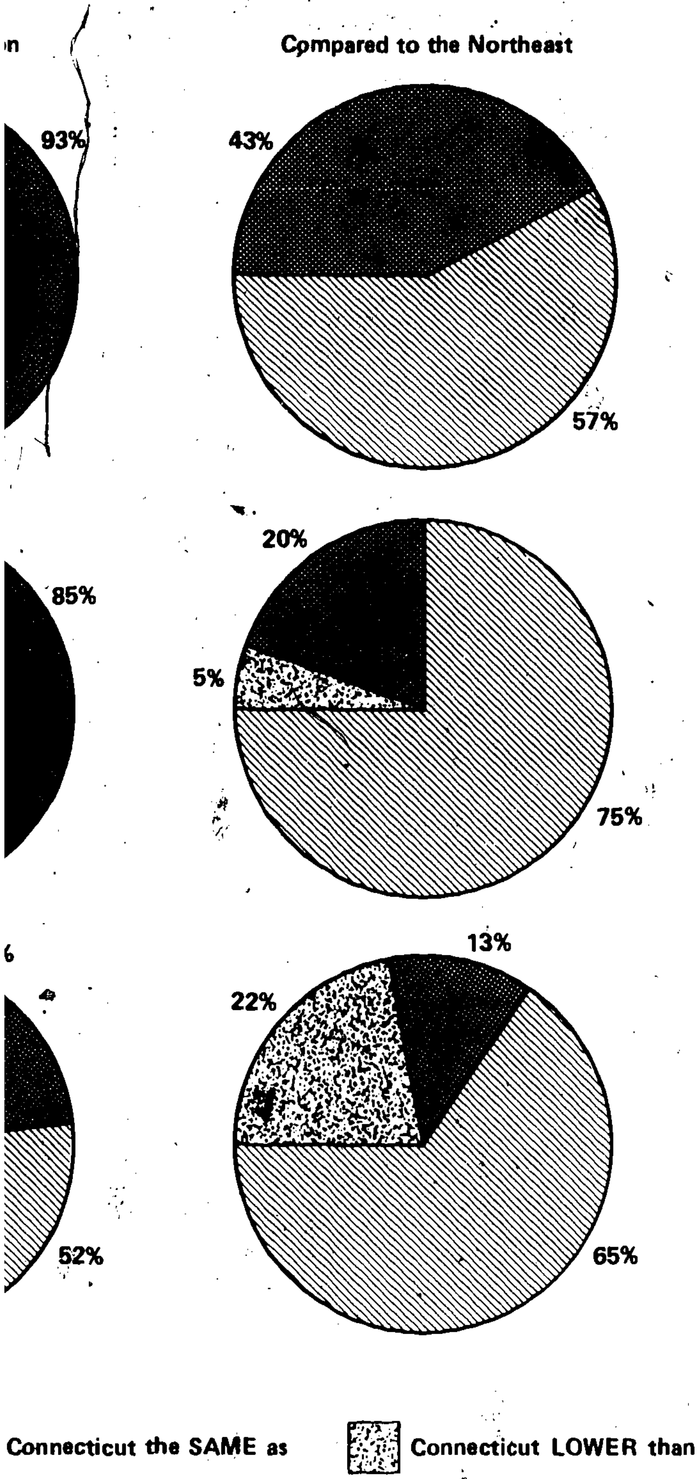


FIGURE 10

ɔn and the Northeast on Selected NAEP Items



Connecticut 9- and 13-year-olds scored significantly above the nation on almost all items, while Connecticut 17-year-olds achieved more highly than the nation on 39% of the items administered to them.

In terms of the average percentage of test items answered correctly, Connecticut 9-year-olds substantially outscored their national counterparts in all goal areas. For this Connecticut age group, the largest difference from the national average was in Computation (16%) and the smallest difference was in Math Concepts (5.5%).

Connecticut 13-year-olds also outscored their national counterparts (by 5-13%) in all goal areas with one exception. In Measurement, Connecticut 13-year-olds scored lower than the nation by approximately 10%. By contrast, Connecticut 17-year-olds scored above the nation on only four of the six goal areas, and then only by a small margin.

*COMPARISONS WITH THE NORTHEAST.* Connecticut 9-year-olds scored lower than the Northeast region on *none* of the test items, while 13-year-olds scored lower on 5% (one of the test items) and 17-year-olds scored lower on 22% (five of the test items) than their Northeast counterparts. Of the three Connecticut age groups, 9-year-olds showed the best comparative performance, scoring higher than their Northeast counterparts on 43% of the items. Connecticut 13-year-olds scored higher than the Northeast on 20% of the items, and Connecticut 17-year-olds on 13% (a total of three items).

The average achievement of Connecticut 9-year-olds was higher than that of their Northeast counterparts on three of the four goal areas. Nine-year-olds performed about the same as Northeast students on Math Concepts. Connecticut 13-year-olds scored above the Northeast in Probelm Solving, Geometry, and Math Concepts, below the Northeast in Measurement and the same as the Northeast in Computation and Charts and Graphs. Connecticut 17-year-olds showed lower average achievement than Northeast students on Math Concepts, Measurement, and Geometry and quite similar achievement in Computation, Charts and Graphs, and Problem Solving.

*OVERVIEW.* In general, the relative performance of Connecticut 9- and 13-year-olds was stronger than that of Connecticut 17-year-olds. However, the achievement of all three Connecticut age groups was better in comparison to the nation than in comparison to the Northeast.

## CHAPTER 4

## ITEM RESULTS BY REPORTING GROUP

This chapter contains tables displaying the results for each item administered to students at each level.

The first three tables presented in this chapter provide the following information for each test item:

- the number of the test question as it appeared in the test booklet
- a specification of the item task
- the percentage of all students answering correctly as well as the percentage in each of the Connecticut reporting groups defined by the variables: sex of student, region, and size of community within the state; and, where the question was also tested by NAEP, the percentage of all students in the nation answering correctly.

Tables 3, 4, and 5 present this information for 9-, 13-, and 17-year-olds, respectively.

Table 6, at the end of this chapter, lists those test questions that were administered to more than one age group. The question numbers are given as they appear in the corresponding test booklets. Table 6 permits the reader to cross-reference results in order to compare the performance of more than one age group on a single test question. When comparing age groups, simply refer to the appropriate table and item number in Tables 3 through 5 to obtain the scores on the items listed here.

## TABLE 3

### Test Item Performance of 9-Year-Old Fourth-Graders in Connecticut by Sex of Student, in Each Region, and in Each Size of Community with National (NAEP) Results Where Applicable

| Question Number | Description of Item | Percentage of Students Answering Correctly: Connecticut: All Students | Sex: M | Sex: F | Region* 1 | Region* 2 | Region* 3 | Region* 4 | Region* 5 | Region* 6 | Size of Community 1 | Size of Community 2 | Size of Community 3 | Size of Community 4 | Nation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | At rate of 5 minutes per window, how could one figure how many minutes to wash 10 windows | 61 | 62 | 61 | 59 | 70 | 68 | 58 | 64 | 61 | 48 | 66 | 60 | 66 | 50 |
| 2 | Fractional part of rectangle shaded (¼) | 61 | 59 | 62 | 60 | 73 | 63 | 61 | 64 | 51 | 47 | 64 | 59 | 67 | |
| 3 | 4613 x 5 = | 78 | 74 | 82 | 79 | 84 | 75 | 79 | 86 | 60 | 76 | 82 | 74 | 80 | |
| 4 | Which is greatest (4-digit numbers ending in 00) | 87 | 89 | 86 | 93 | 90 | 89 | 90 | 88 | 88 | 76 | 90 | 90 | 90 | |
| 5 | A quarter equals how many nickels | 92 | 93 | 91 | 94 | 94 | 93 | 92 | 94 | 90 | 86 | 92 | 93 | 94 | |
| 6 | Time shown on clock (7:55) | 59 | 63 | 55 | 62 | 70 | 63 | 54 | 58 | 57 | 46 | 61 | 60 | 62 | |
| 7 | Estimate height of girl in fourth grade | 68 | 72 | 65 | 74 | 74 | 69 | 71 | 74 | 68 | 52 | 71 | 69 | 75 | |
| 8 | Identify digit in tens place | 79 | 80 | 79 | 83 | 81 | 85 | 81 | 81 | 89 | 62 | 82 | 80 | 85 | 75 |
| 9 | At $2 per shirt, how much would 7 shirts cost | 85 | 86 | 84 | 87 | 91 | 87 | 86 | 87 | 81 | 76 | 88 | 85 | 88 | |
| 10 | Which is greatest (5-digit numbers) | 65 | 66 | 64 | 69 | 70 | 70 | 65 | 64 | 63 | 51 | 68 | 69 | 66 | |
| 11 | 402 x 7 = | 68 | 65 | 70 | 69 | 74 | 67 | 69 | 78 | 51 | 56 | 73 | 68 | 70 | |
| 12** | Feet of fencing to enclose garden 9 feet long, 5 feet wide | 8 | 11 | 6 | 8 | 12 | 9 | 7 | 12 | 6 | 4 | 10 | 7 | 11 | 7 |
| 13** | 1054 - 865 = | 51 | 48 | 53 | 57 | 59 | 51 | 56 | 52 | 43 | 37 | 54 | 51 | 56 | 27 |
| 14 | Place values in 762 | 81 | 82 | 80 | 85 | 83 | 87 | 81 | 87 | 79 | 64 | 84 | 84 | 86 | 74 |
| 15 | Which number is least (whole numbers) | 83 | 83 | 83 | 86 | 86 | 84 | 86 | 86 | 82 | 73 | 86 | 83 | 87 | |
| 16 | A nickel equals how many pennies | 95 | 95 | 95 | 96 | 96 | 97 | 97 | 98 | 94 | 88 | 96 | 96 | 98 | |
| 17 | Pictograph—on which day did most people use library | 95 | 94 | 96 | 97 | 97 | 97 | 95 | 98 | 97 | 86 | 96 | 95 | 99 | |
| 18 | Pictograph—how many people used library on specific day (symbol = 20 people) | 38 | 40 | 36 | 43 | 43 | 47 | 33 | 46 | 42 | 15 | 39 | 40 | 47 | |
| 19 | Rocket aimed at target 525 miles south, landed 624 miles south. Missed target by how many miles | 39 | 40 | 39 | 43 | 48 | 44 | 45 | 43 | 31 | 19 | 43 | 43 | 45 | 22 |
| 20** | 38 + 19 = | 89 | 87 | 90 | 89 | 91 | 92 | 90 | 92 | 82 | 82 | 91 | 89 | 91 | 79 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21** | 36 - 19 = | 77 | 76 | 79 | 83 | 82 | 80 | 76 | 83 | 75 | 64 | 79 | 79 | 82 | 55 |
| 22** | $3.06 + 10.00 + 9.14 + 5.10 + | 48 | 47 | 49 | 46 | 55 | 53 | 56 | 56 | 35 | 30 | 49 | 53 | 54 | 40 |
| 23** | At 2 biscuits per day, how long until dog eats 24 biscuits | 51 | 55 | 47 | 55 | 57 | 54 | 51 | 59 | 44 | 33 | 54 | 52 | 57 | 37 |
| 24 | Time shown on clock (10 to 4) | 76 | 76 | 75 | 82 | 77 | 79 | 76 | 80 | 71 | 63 | 75 | 77 | 81 | |
| 25 | Sum of hundreds, tens, ones | 78 | 80 | 77 | 82 | 84 | 84 | 81 | 80 | 72 | 63 | 84 | 80 | 82 | |
| 26 | Best unit to measure between two cities | 95 | 96 | 94 | 96 | 97 | 94 | 96 | 97 | 90 | 91 | 97 | 94 | 96 | |
| 27 | Fractional part of circle shaded (1/6) | 63 | 62 | 64 | 64 | 74 | 65 | 64 | 69 | 49 | 50 | 67 | 65 | 67 | |
| 28 | Figure which has the same area as figure shown (all rectangles) | 54 | 57 | 51 | 53 | 66 | 54 | 52 | 53 | 44 | 48 | 55 | 55 | 55 | 38 |
| 29 | 659 - 207 = | 88 | 88 | 89 | 89 | 90 | 91 | 90 | 92 | 81 | 80 | 89 | 90 | 91 | |
| 30 | Best unit to measure toothbrush | 87 | 88 | 86 | 89 | 91 | 89 | 87 | 89 | 89 | 77 | 89 | 87 | 90 | |
| 31 | 36 x 3 = | 81 | 79 | 82 | 79 | 87 | 82 | 85 | 88 | 71 | 70 | 85 | 77 | 86 | |
| 32 | 826 + 786 = | 87 | 85 | 88 | 86 | 92 | 87 | 88 | 90 | 85 | 79 | 88 | 88 | 89 | |
| 33 | Length of pencil to nearest inch | 93 | 93 | 92 | 92 | 95 | 94 | 96 | 96 | 86 | 85 | 94 | 93 | 96 | |
| 34 | 312 x 4 = | 89 | 87 | 91 | 90 | 91 | 89 | 93 | 94 | 81 | 82 | 92 | 89 | 91 | |
| 35 | From 4:25 to 5:00 P.M. is how many minutes | 45 | 51 | 40 | 49 | 52 | 49 | 42 | 44 | 36 | 36 | 47 | 47 | 47 | |
| 36 | Fraction of dots colored in (2/7) | 73 | 72 | 74 | 73 | 82 | 78 | 74 | 77 | 74 | 57 | 77 | 74 | 79 | |
| 37 | Bar graph—who weighs most | 96 | 96 | 95 | 98 | 97 | 97 | 97 | 99 | 97 | 87 | 96 | 98 | 97 | 89 |
| 38 | Bar graph—who weighs closest to 50 pounds | 70 | 74 | 66 | 71 | 74 | 74 | 73 | 76 | 68 | 52 | 72 | 72 | 76 | 61 |
| 39 | Bar graph—who weighs least | 94 | 95 | 94 | 97 | 96 | 98 | 96 | 98 | 97 | 83 | 97 | 96 | 98 | 84 |
| 40 | 63 x 3 = | 89 | 88 | 90 | 90 | 93 | 88 | 92 | 95 | 83 | 81 | 93 | 86 | 92 | |
| 41 | Fractional part of circle shaded (2/5) | 72 | 70 | 73 | 70 | 81 | 76 | 75 | 74 | 65 | 57 | 77 | 70 | 77 | |
| 42 | Next number after 98, 99, 100, | 95 | 94 | 95 | 98 | 97 | 96 | 97 | 98 | 93 | 85 | 97 | 96 | 97 | |
| 43 | Place value of 7 in 7000 | 78 | 79 | 76 | 76 | 83 | 82 | 80 | 81 | 81 | 64 | 80 | 81 | 81 | |
| 44 | A half dollar equals how many dimes | 64 | 69 | 60 | 66 | 70 | 71 | 63 | 71 | 67 | 46 | 65 | 68 | 71 | |
| 45 | 476 - 38 = | 76 | 73 | 79 | 80 | 81 | 82 | 75 | 77 | 71 | 63 | 81 | 75 | 81 | |
| 46 | Amount of change from $5 for a $1.40 purchase | 39 | 38 | 41 | 39 | 45 | 42 | 39 | 47 | 33 | 26 | 39 | 41 | 45 | |
| 47 | Time shown on clock (6:25) | 83 | 86 | 81 | 82 | 90 | 87 | 81 | 85 | 83 | 73 | 85 | 84 | 87 | |
| 48 | Length of nail to nearest centimeter | 92 | 93 | 92 | 92 | 94 | 93 | 96 | 97 | 88 | 84 | 93 | 94 | 95 | |
| 49 | Twenty pennies equal how many nickels | 79 | 80 | 78 | 80 | 84 | 84 | 80 | 88 | 71 | 62 | 83 | 82 | 83 | |
| 50 | 2 nickels, 1 quarter, and 4 pennies equal how much money | 81 | 80 | 83 | 85 | 86 | 85 | 81 | 85 | 71 | 71 | 84 | 83 | 84 | |
| 51 | Time it was two hours ago | 68 | 70 | 65 | 67 | 73 | 75 | 69 | 77 | 75 | 45 | 71 | 67 | 78 | |
| 52 | Fractional part of rectangle shaded (4/8) | 63 | 61 | 64 | 57 | 72 | 68 | 65 | 68 | 56 | 50 | 65 | 63 | 68 | |
| 53 | 634 + 41 + 5122 = | 91 | 89 | 92 | 91 | 94 | 92 | 92 | 95 | 90 | 83 | 93 | 92 | 93 | |
| 54 | Total of 8 apples, 17 apples, and 37 apples | 82 | 80 | 83 | 83 | 85 | 83 | 86 | 87 | 74 | 71 | 83 | 82 | 86 | |
| 55 | Value of 4 in 3654 | 80 | 81 | 79 | 86 | 84 | 86 | 84 | 86 | 79 | 57 | 86 | 82 | 87 | |
| 56 | 861 - 583 = | 75 | 72 | 77 | 79 | 82 | 77 | 77 | 76 | 71 | 60 | 79 | 75 | 79 | |
| 57 | Time it will be in one-half hour | 89 | 91 | 88 | 89 | 93 | 92 | 91 | 94 | 93 | 78 | 91 | 91 | 94 | |
| 58 | Number 10 more than 4375 | 59 | 64 | 55 | 63 | 66 | 64 | 61 | 63 | 49 | 40 | 64 | 59 | 65 | |
| 59 | 725 + 203 = | 93 | 91 | 94 | 92 | 96 | 95 | 93 | 95 | 93 | 87 | 94 | 94 | 95 | |
| 60 | A dollar equals how many quarters | 87 | 89 | 85 | 91 | 91 | 90 | 86 | 90 | 88 | 73 | 90 | 90 | 89 | |

* Regions do not include "Big Cities."
** Open-ended item.

## TABLE 4

### Test Item Performance of 13-Year-Old Eighth-Graders in Connecticut by Sex of Student, in Each Region, and in Each Size of Community with National (NAEP) Results Where Applicable

| Question Number | Description of Item | Connecticut: All Students | Sex: M | Sex: F | Region* 1 | Region* 2 | Region* 3 | Region* 4 | Region* 5 | Region* 6 | Size of Community 1 | Size of Community 2 | Size of Community 3 | Size of Community 4 | Nation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1** | 38 x 9 = | 87 | 85 | 88 | 87 | 88 | 86 | 89 | 86 | 88 | 81 | 86 | 87 | 89 | 83 |
| 2 | 30 inches = __ feet __ inches | 86 | 90 | 93 | 86 | 86 | 89 | 88 | 89 | 88 | 67 | 87 | 86 | 91 | |
| 3** | 38 + 19 = | 96 | 95 | 96 | 97 | 95 | 96 | 96 | 95 | 94 | 93 | 96 | 96 | 96 | 94 |
| 4 | Picture of parallel lines | 94 | 96 | 93 | 93 | 95 | 96 | 96 | 96 | 85 | 82 | 96 | 93 | 96 | |
| 5 | 13 boys and 15 girls in a group, what fractional part is boys | 32 | 33 | 32 | 28 | 32 | 36 | 34 | 33 | 36 | 25 | 34 | 30 | 35 | |
| 6 | .009 is equivalent to what fraction | 70 | 70 | 69 | 71 | 69 | 73 | 72 | 66 | 73 | 55 | 70 | 70 | 73 | |
| 7 | Which number is least (whole numbers) | 98 | 98 | 98 | 98 | 99 | 98 | 98 | 97 | 99 | 96 | 98 | 97 | 99 | |
| 8 | 826 + 786 = | 97 | 96 | 97 | 99 | 97 | 97 | 96 | 96 | 99 | 96 | 97 | 96 | 97 | |
| 9** | 36 - 19 = | 93 | 93 | 93 | 93 | 94 | 93 | 95 | 91 | 93 | 90 | 94 | 92 | 94 | 89 |
| 10** | Several people received votes, what percentage of total vote did one of the people receive | 27 | 33 | 23 | 26 | 34 | 32 | 24 | 27 | 19 | 15 | 30 | 24 | 30 | 17 |
| 11** | At 10% and 15% discount, what is the difference in prices for TV set regularly priced at $100 | 61 | 65 | 57 | 56 | 65 | 64 | 62 | 64 | 57 | 45 | 63 | 60 | 63 | 49 |
| 12** | 1054 - 865 = | 87 | 87 | 87 | 89 | 86 | 87 | 89 | 87 | 90 | 77 | 88 | 86 | 89 | 80 |
| 13 | Line segment in a circle which is the diameter | 74 | 78 | 70 | 74 | 78 | 76 | 75 | 68 | 69 | 60 | 76 | 73 | 74 | 68 |
| 14 | Fraction that is greatest | 30 | 40 | 22 | 29 | 33 | 36 | 29 | 28 | 21 | 16 | 31 | 26 | 37 | 26 |
| 15 | 714 ÷ 7 = | 74 | 73 | 74 | 72 | 79 | 73 | 76 | 72 | 61 | 66 | 74 | 75 | 74 | |
| 16 | 46 x 50 = | 95 | 94 | 96 | 94 | 97 | 95 | 96 | 94 | 94 | 88 | 96 | 94 | 95 | |
| 17 | 0.6 + 8 + .24 = | 83 | 85 | 81 | 82 | 89 | 85 | 84 | 82 | 67 | 67 | 84 | 84 | 84 | |
| 18* | Fractional part of circle shaded | 93 | 93 | 94 | 91 | 96 | 96 | 95 | 91 | 87 | 82 | 95 | 92 | 95 | |
| 19 | Number that is greatest (decimals) | 86 | 91 | 81 | 86 | 92 | 89 | 86 | 80 | 79 | 69 | 89 | 83 | 88 | 84 |
| 20 | 74 x 38 = | 89 | 87 | 90 | 87 | 92 | 90 | 91 | 86 | 88 | 80 | 90 | 88 | 91 | |
| 21 | $8.96 ÷ 4 = | 91 | 90 | 92 | 91 | 92 | 93 | 91 | 88 | 91 | 86 | 92 | 89 | 93 | |
| 22 | $\frac{1}{2} + \frac{1}{3}$ = | 60 | 59 | 60 | 61 | 69 | 60 | 61 | 56 | 61 | 37 | 61 | 58 | 66 | |
| 23** | Feet of fencing to enclose garden 9 feet long and 5 feet wide | 45 | 53 | 38 | 40 | 49 | 51 | 47 | 41 | 40 | 27 | 47 | 44 | 48 | |
| 24** | $3.06 + 10.00 + 9.14 + 5.10 = | 88 | 87 | 89 | 87 | 93 | 91 | 88 | 86 | 93 | 76 | 91 | 86 | 90 | 84 |
| 25** | $\frac{1}{5}$ is equivalent to what percent | 55 | 60 | 50 | 52 | 59 | 63 | 53 | 51 | 58 | 30 | 59 | 50 | 61 | 41 |
| 26** | Person left for work at 7:45 A.M., returned home 10 hours later at what time | 80 | 82 | 78 | 82 | 81 | 83 | 80 | 79 | 69 | 63 | 83 | 78 | 82 | 63 |
| 27** | 125 ÷ 5 = | 94 | 93 | 94 | 95 | 97 | 94 | 94 | 91 | 87 | 87 | 95 | 92 | 95 | 89 |
| 28 | Distance on map is 3 inches. At scale of 1 inch = 45 miles, what is actual distance between the cities | 95 | 96 | 94 | 97 | 96 | 96 | 96 | 94 | 97 | 85 | 96 | 95 | 97 | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | 4.2 x 0.3 = | 70 | 68 | 72 | 74 | 80 | 69 | 71 | 66 | 73 | 51 | 75 | 64 | 77 | |
| 30 | Sales tax of 3 cents on a dollar, what is tax on a $10 purchase | 95 | 95 | 94 | 95 | 96 | 96 | 94 | 94 | 94 | 88 | 96 | 95 | 95 | |
| 31 | Metric unit used to measure distance between two cities | 73 | 82 | 65 | 78 | 81 | 75 | 75 | 65 | 54 | 54 | 77 | 70 | 76 | |
| 32 | 609 x 73 = | 91 | 90 | 92 | 92 | 95 | 91 | 91 | 91 | 94 | 85 | 93 | 91 | 93 | |
| 33 | Area of rectangle shown (6 inches by 2 inches) | 56 | 58 | 54 | 63 | 64 | 59 | 52 | 53 | 45 | 36 | 59 | 49 | 64 | |
| 34 | $\frac{1}{2} \times \frac{1}{4}$ = | 80 | 78 | 81 | 79 | 82 | 79 | 79 | 80 | 87 | 77 | 80 | 77 | 82 | |
| 35 | $4\frac{1}{2} - 2\frac{1}{4}$ = | 80 | 78 | 82 | 79 | 86 | 82 | 80 | 83 | 79 | 64 | 81 | 82 | 82 | |
| 36 | 425 x 0.33 = | 86 | 86 | 86 | 89 | 88 | 85 | 89 | 83 | 88 | 74 | 90 | 83 | 87 | |
| 37 | Metric unit used to measure page of test | 77 | 81 | 74 | 79 | 84 | 79 | 79 | 73 | 72 | 54 | 81 | 75 | 81 | |
| 38 | $\frac{2}{3} \times \frac{3}{4}$ = | 79 | 80 | 78 | 73 | 84 | 81 | 81 | 80 | 82 | 64 | 81 | 76 | 84 | |
| 39 | Kind of angle found in a square | 71 | 72 | 69 | 76 | 74 | 74 | 73 | 66 | 49 | 46 | 72 | 71 | 75 | |
| 40 | 2 hours 20 minutes = __ minutes | 93 | 95 | 91 | 92 | 95 | 95 | 94 | 91 | 93 | 79 | 94 | 92 | 96 | |
| 41 | Reading a circle graph | 87 | 88 | 87 | 88 | 89 | 89 | 89 | 86 | 84 | 78 | 89 | 86 | 90 | |
| 42 | $1.98 x 4 = | 92 | 92 | 92 | 94 | 94 | 92 | 92 | 95 | 91 | 85 | 92 | 92 | 94 | |
| 43 | $1.29 x 0.06 = | 57 | 56 | 58 | 60 | 62 | 57 | 60 | 51 | 63 | 38 | 63 | 51 | 60 | |
| 44 | Smallest metric unit of measurement | 68 | 75 | 63 | 67 | 79 | 73 | 71 | 62 | 51 | 40 | 74 | 64 | 73 | |
| 45 | Shape most like an orange (sphere) | 83 | 86 | 80 | 88 | 85 | 83 | 86 | 78 | 67 | 67 | 83 | 83 | 85 | |
| 46 | Reading a table of sock sizes | 88 | 88 | 88 | 90 | 93 | 89 | 91 | 86 | 82 | 69 | 91 | 87 | 91 | |
| 47 | $4\frac{1}{2} \times 3$ = | 68 | 71 | 66 | 70 | 74 | 70 | 68 | 69 | 64 | 49 | 72 | 65 | 72 | |
| 48** | Mary took four tests and received four different numbers of items correct. How many items were incorrect | 76 | 77 | 76 | 75 | 81 | 79 | 78 | 76 | 63 | 61 | 79 | 76 | 78 | 60 |
| 49** | $1\frac{1}{2}$ pounds = __ ounces | 58 | 66 | 50 | 52 | 57 | 62 | 62 | 58 | 52 | 41 | 60 | 56 | 61 | |
| 50** | If 23.8 is subtracted from 62.1 | 72 | 72 | 72 | 73 | 77 | 76 | 74 | 69 | 64 | 54 | 74 | 71 | 76 | 61 |
| 51** | Three people earned money. What was average amount earned | 56 | 59 | 53 | 61 | 64 | 60 | 58 | 46 | 40 | 31 | 61 | 53 | 59 | 38 |
| 52** | Rocket aimed at target missed target by how many miles | 81 | 82 | 81 | 80 | 88 | 84 | 82 | 79 | 76 | 64 | 85 | 78 | 84 | 72 |
| 53 | Reading a chart with symbol for a kind of unit | 93 | 93 | 93 | 94 | 94 | 93 | 92 | 92 | 88 | 87 | 93 | 92 | 94 | |
| 54 | At average speed of 50 MPH, how many hours to travel 275 miles | 51 | 59 | 44 | 46 | 52 | 57 | 54 | 46 | 40 | 34 | 54 | 49 | 52 | |
| 55 | Perimeter of triangle shown (17 cm by 24 cm by 32 cm) | 82 | 84 | 80 | 82 | 83 | 83 | 82 | 84 | 75 | 72 | 81 | 82 | 86 | |
| 56 | $\frac{7}{8} \times 2$ = | 73 | 73 | 73 | 72 | 75 | 74 | 76 | 75 | 69 | 58 | 76 | 71 | 76 | |
| 57 | Figure which has same area as figure shown (all rectangles) | 84 | 84 | 84 | 86 | 89 | 86 | 83 | 80 | 79 | 74 | 89 | 81 | 84 | |
| 58 | Gram is used to measure (weight) | 85 | 89 | 82 | 87 | 89 | 87 | 88 | 82 | 72 | 68 | 90 | 82 | 86 | |
| 59 | $\frac{5}{6} - \frac{1}{3}$ = | 53 | 53 | 54 | 58 | 62 | 53 | 53 | 55 | 46 | 31 | 57 | 51 | 58 | |
| 60 | 339 : 22 = | 84 | 82 | 85 | 86 | 85 | 85 | 84 | 82 | 78 | 73 | 84 | 84 | 85 | |
| 61 | $10.00 - 1.98 = | 85 | 86 | 84 | 88 | 89 | 86 | 84 | 82 | 85 | 78 | 86 | 85 | 86 | |
| 62 | 8 quarts = __ gallons | 76 | 82 | 71 | 73 | 79 | 81 | 77 | 75 | 73 | 62 | 79 | 74 | 79 | |
| 63 | $2\frac{1}{8} + 3\frac{7}{8}$ = | 64 | 65 | 63 | 62 | 73 | 65 | 66 | 64 | 64 | 40 | 67 | 61 | 68 | |
| 64 | Sales tax of 6%, what is tax on $200 TV set | 60 | 64 | 56 | 59 | 59 | 64 | 60 | 57 | 63 | 53 | 60 | 61 | 61 | |
| 65** | Reading a bar graph | 92 | 91 | 92 | 93 | 91 | 93 | 93 | 89 | 90 | 84 | 93 | 91 | 93 | |
| 66 | Ordering fractions | 32 | 39 | 26 | 30 | 35 | 37 | 31 | 30 | 25 | 18 | 34 | 32 | 33 | |

* Regions do not include "Big Cities."

** Open-ended item.

# TABLE 5

## Test Item Performance of 17-Year-Old Eleventh-Graders in Connecticut by Sex of Student, in Each Region, and in Each Size of Community with National (NAEP) Results Where Applicable

| Question Number | Description of Item | Percentage of Students Answering Correctly: Connecticut — All Students | Sex: M | Sex: F | Region* 1 | Region* 2 | Region* 3 | Region* 4 | Region* 5 | Region* 6 | Size of Community 1 | Size of Community 2 | Size of Community 3 | Size of Community 4 | Nation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 714 : 7 = | 77 | 79 | 76 | 79 | 78 | 77 | 81 | 81 | 75 | 66 | 79 | 77 | 80 | |
| 2 | $4\frac{1}{4} - 2\frac{1}{2}$ = | 64 | 72 | 57 | 68 | 67 | 67 | 61 | 66 | 71 | 46 | 63 | 67 | 68 | |
| 3 | 0.6 + 8 + .24 = | 87 | 88 | 87 | 87 | 94 | 90 | 83 | 89 | 92 | 75 | 88 | 90 | 89 | |
| 4** | 38 x 9 = | 88 | 87 | 89 | 89 | 88 | 90 | 86 | 90 | 83 | 86 | 89 | 89 | 88 | 88 |
| 5** | Degrees of angle formed by hands of clock at 3 o'clock | 72 | 78 | 67 | 79 | 77 | 79 | 67 | 74 | 65 | 52 | 75 | 76 | 75 | 73 |
| 6** | 38 + 19 = | 97 | 97 | 97 | 97 | 98 | 97 | 95 | 98 | 99 | 97 | 97 | 97 | 97 | 97 |
| 7** | $\frac{1}{5}$ is equivalent to what percent | 63 | 68 | 60 | 65 | 74 | 67 | 62 | 59 | 71 | 45 | 68 | 64 | 66 | 65 |
| 8** | Several people received votes, what percentage of total vote did one of the people receive | 46 | 59 | 36 | 47 | 53 | 50 | 45 | 46 | 54 | 30 | 47 | 51 | 47 | 45 |
| 9 | Fraction describing shaded portion of figure | 86 | 86 | 86 | 85 | 88 | 88 | 86 | 87 | 86 | 81 | 88 | 86 | 87 | |
| 10 | 339 ÷ 22 = | 91 | 91 | 91 | 92 | 93 | 94 | 91 | 91 | 94 | 81 | 94 | 93 | 91 | |
| 11 | Reading a table of sock sizes | 94 | 93 | 94 | 94 | [illegible] | 96 | 95 | 95 | 99 | 83 | 96 | 96 | 95 | |
| 12 | One gallon of paint covers 250 square feet, how many gallons are needed to cover a wall 48 feet by 10 feet | 70 | 77 | 65 | 77 | 76 | 77 | 66 | 70 | 72 | 51 | 72 | 74 | 75 | |
| 13** | Reading a bar graph | 91 | 93 | 89 | 91 | 92 | 92 | 90 | 93 | 94 | 85 | 93 | 91 | 91 | |
| 14** | 36 - 19 = | 95 | 95 | 95 | 94 | 97 | 96 | 96 | 95 | 95 | 92 | 96 | 97 | 95 | 92 |
| 15** | $3.06 + 10.00 + 9.14 + 5.10 = | 94 | 93 | 95 | 95 | 96 | 93 | 92 | 95 | 94 | 92 | 94 | 95 | 94 | 93 |
| 16** | Three people earned money. What was the average amount earned | 72 | 76 | 79 | 73 | 77 | 78 | 72 | [illegible] | [illegible] | 51 | 73 | 76 | 78 | 66 |
| 17** | 125 ÷ 5 = | 95 | 94 | 95 | 97 | 97 | 95 | 93 | 96 | 92 | 91 | 96 | 95 | 95 | 93 |
| 18 | 8 quarts = __ gallons | 84 | 89 | 80 | 86 | 82 | 86 | 86 | [illegible] | 92 | 71 | 84 | 88 | 85 | |
| 19 | Metric unit used to measure distance between two cities | 77 | 87 | 69 | 80 | 84 | 82 | 72 | 80 | 74 | 57 | 76 | 80 | 82 | |
| 20 | 609 x 73 = | 95 | 96 | 95 | 96 | 94 | 95 | 95 | 98 | 97 | 91 | 94 | 96 | 97 | |
| 21 | Reading a circle graph | 96 | 95 | 96 | 96 | 97 | 97 | 95 | 96 | 100 | 89 | 97 | 97 | 96 | |
| 22 | Ordering fractions | 57 | 70 | 46 | 60 | 63 | 62 | 54 | 57 | 66 | 37 | 58 | 57 | 63 | |
| 23** | Height of tent pole (use of right triangle) | 39 | 47 | 33 | 41 | 51 | 44 | 34 | 36 | 43 | 23 | 42 | 40 | 42 | 34 |
| 24** | If 23.8 is subtracted from 62.1 | 84 | 82 | 86 | 89 | 88 | 86 | 84 | 85 | 88 | 72 | 86 | 86 | 87 | 78 |
| 25** | Feet of fencing to enclose garden 9 feet long and 5 feet wide | 59 | 71 | 50 | 62 | 63 | 63 | 60 | 64 | 71 | 34 | 59 | 62 | 66 | |
| 26** | 1054 - 865 = | 92 | 91 | 93 | 94 | 93 | 95 | 91 | 93 | 95 | 86 | 92 | 94 | 94 | 89 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27** | If 300 calories in 9 ounces of a food, how many calories in 3 ounces of the food | 79 | 82 | 77 | 82 | 80 | 85 | 79 | 81 | 88 | 62 | 81 | 81 | 84 | 70 |
| 28 | 826 + 786 = | 95 | 95 | 95 | 97 | 97 | 95 | 96 | 94 | 97 | 91 | 97 | 96 | 95 | |
| 29 | Given formula for area of triangle, find area of triangle with b = 4 and h = 10 | 88 | 88 | 88 | 91 | 94 | 90 | 87 | 89 | 99 | 72 | 90 | 90 | 91 | |
| 30 | Sales tax of 6%, what is tax on $200 TV set | 80 | 82 | 78 | 86 | 79 | 82 | 79 | 78 | 86 | 72 | 81 | 80 | 81 | |
| 31 | Gram is used to measure (weight) | 93 | 97 | 91 | 95 | 95 | 95 | 94 | 96 | 95 | 82 | 95 | 96 | 95 | |
| 32 | $4\frac{1}{2}$ x 3 = | 80 | 85 | 77 | 85 | 85 | 83 | 80 | 82 | 85 | 62 | 82 | 85 | 83 | |
| 33 | 30 inches = __ feet __ inches | 92 | 94 | 90 | 95 | 95 | 95 | 92 | 95 | 94 | 77 | 94 | 94 | 95 | |
| 34 | $\frac{1}{2}$ x $\frac{1}{4}$ = | 85 | 83 | 86 | 86 | 86 | 83 | 85 | 84 | 95 | 83 | 87 | 84 | 84 | |
| 35 | .009 is equivalent to what fraction | 74 | 78 | 70 | 75 | 80 | 78 | 73 | 73 | 79 | 58 | 79 | 73 | 76 | |
| 36 | $74.46 : 17 = | 88 | 88 | 88 | 89 | 90 | 91 | 87 | 90 | 88 | 78 | 89 | 89 | 89 | |
| 37 | $10.00 - 1.98 = | 90 | 91 | 90 | 92 | 91 | 93 | 88 | 91 | 92 | 85 | 89 | 92 | 92 | |
| 38 | $1.29 x 0.06 = | 71 | 70 | 72 | 76 | 74 | 72 | 69 | 74 | 79 | 59 | 74 | 71 | 74 | |
| 39** | How much more would a person pay to buy a certain car on credit than by paying cash | 57 | 60 | 55 | 59 | 60 | 62 | 56 | 61 | 63 | 39 | 60 | 62 | 58 | 56 |
| 40** | $1\frac{1}{2}$ pounds = __ ounces | 74 | 81 | 69 | 78 | 74 | 91 | 76 | 78 | 77 | 51 | 74 | 79 | 80 | |
| 41** | Parking lot charges 35¢ first hour, 25¢ for each additional hour or fraction, what is the cost to park from 10:45 A.M. to 3:05 P.M. | 54 | 58 | 52 | 59 | 59 | 56 | 54 | 55 | 57 | 40 | 55 | 58 | 57 | 47 |
| 42** | Degrees of third angle of a triangle | 52 | 55 | 49 | 59 | 57 | 55 | 44 | 59 | 45 | 36 | 50 | 53 | 59 | 52 |
| 43** | Person left for work at 7:45 A.M., returned home 10 hours later at what time | 87 | 89 | 84 | 88 | 89 | 89 | 89 | 87 | 91 | 74 | 89 | 89 | 88 | 82 |
| 44 | Find volume of box | 75 | 80 | 71 | 76 | 81 | 80 | 73 | 76 | 89 | 54 | 75 | 78 | 80 | |
| 45 | 425 x 0.33 = | 88 | 85 | 90 | 90 | 89 | 89 | 88 | 90 | 91 | 77 | 90 | 90 | 89 | |
| 46 | $\frac{7}{6}$ - $\frac{1}{3}$ = | 66 | 66 | 66 | 71 | 75 | 72 | 60 | 69 | 66 | 44 | 69 | 70 | 69 | |
| 47 | 1.96 : 0.4 = | 71 | 71 | 70 | 71 | 76 | 72 | 68 | 75 | 74 | 59 | 72 | 71 | 74 | |
| 48 | Metric unit used to measure capacity of gasoline tank | 86 | 92 | 81 | 88 | 91 | 88 | 86 | 89 | 94 | 68 | 88 | 89 | 89 | |
| 49 | Number that is greatest (decimals) | 93 | 95 | 91 | 96 | 96 | 96 | 92 | 94 | 94 | 79 | 95 | 96 | 94 | 93 |
| 50 | Reading a line graph | 93 | 94 | 92 | 95 | 96 | 95 | 93 | 94 | 95 | 82 | 94 | 95 | 96 | |
| 51 | 17 : 0.25 = | 60 | 62 | 58 | 60 | 59 | 66 | 62 | 65 | 60 | 44 | 60 | 63 | 63 | |
| 52 | 74 x 38 = | 89 | 87 | 90 | 87 | 91 | 92 | 87 | 89 | 91 | 83 | 89 | 91 | 89 | |
| 53 | Number that is smallest (decimals) | 77 | 83 | 73 | 78 | 85 | 82 | 74 | 80 | 83 | 57 | 81 | 79 | 80 | 75 |
| 54 | $\frac{3}{8}$ : 2 = | 66 | 66 | 66 | 70 | 69 | 69 | 62 | 70 | 74 | 49 | 67 | 68 | 69 | |
| 55 | 46 x 50 = | 95 | 94 | 96 | 97 | 94 | 97 | 95 | 96 | 94 | 90 | 95 | 97 | 96 | |
| 56 | $2\frac{3}{8}$ + $3\frac{7}{8}$ = | 76 | 78 | 76 | 79 | 80 | 81 | 78 | 78 | 80 | 58 | 79 | 80 | 80 | |
| 57 | Smallest metric unit of measure | 73 | 79 | 68 | 76 | 82 | 80 | 73 | 73 | 79 | 50 | 75 | 79 | 77 | |
| 58 | At average speed of 50 MPH, how many hours to travel 275 miles | 58 | 67 | 50 | 59 | 62 | 63 | 57 | 56 | 60 | 45 | 60 | 59 | 60 | |
| 59 | Fraction that is greatest | 45 | 61 | 34 | 44 | 54 | 52 | 46 | 43 | 49 | 27 | 50 | 48 | 48 | 49 |
| 60 | Estimate circumference of circle given the diameter | 32 | 42 | 25 | 34 | 35 | 35 | 31 | 32 | 34 | 23 | 32 | 34 | 35 | |
| 61 | $\frac{1}{2}$ + $\frac{1}{3}$ = | 72 | 73 | 71 | 77 | 80 | 76 | 69 | 74 | 68 | 52 | 74 | 75 | 75 | |
| 62 | 13 boys and 15 girls in a group, what fractional part is boys | 52 | 53 | 50 | 58 | 56 | 55 | 46 | 51 | 49 | 42 | 51 | 54 | 54 | |
| 63 | 3 : $\frac{3}{4}$ = | 58 | 58 | 58 | 62 | 58 | 64 | 58 | 59 | 59 | 47 | 64 | 61 | 57 | |
| 64 | 2 hours 20 minutes = __ minutes | 94 | 95 | 93 | 95 | 95 | 96 | 96 | 94 | 97 | 83 | 96 | 96 | 95 | |

Regions do not include "Big Cities."
Open-ended item.

TABLE 6

Questions Administered to More Than One Age Group

| Corresponding Question Numbers | | |
|---|---|---|
| 9-Year-Olds (Fourth-Grade Test) | 13-Year-Olds (Eighth-Grade Test) | 17-Year-Olds (Eleventh-Grade Test) |
| #41 | #18 | |
| | #5 | #62 |
| | #25 | #7 |
| | #6 | #35 |
| | #19 | #49 |
| | #14 | #59 |
| #15 | #7 | |
| | #66 | #22 |
| #20 | #3 | #6 |
| #21 | #9 | #14 |
| #32 | #8 | #28 |
| #13 | #12 | #26 |
| #22 | #24 | #15 |
| | #1 | #4 |
| | #16 | #55 |
| | #20 | #52 |
| | #32 | #20 |
| | #27 | #17 |
| | #15 | #1 |
| | #60 | #10 |
| | #61 | #37 |
| | #17 | #3 |
| | #50 | #24 |
| | #36 | #45 |
| | #43 | #38 |
| | #22 | #61 |
| | #63 | #56 |
| | #59 | #46 |
| | #47 | #32 |
| | #34 | #34 |
| #12 | #23 | #25 |
| #28 | #57 | |
| | #49 | #40 |
| | #62 | #18 |
| | #40 | #64 |
| | #2 | #33 |
| | #31 | #19 |
| | #44 | #57 |
| | #58 | #31 |
| #19 | #52 | |
| | #65 | #13 |
| | #46 | #11 |
| | #41 | #21 |
| | #51 | #16 |
| | #10 | #8 |
| | #26 | #43 |
| | #54 | #58 |
| | #64 | #30 |

# PART II

## INTERPRETATIONS AND RECOMMENDATIONS

# CHAPTER 5

## INTRODUCTION

This section of the report contains an analysis and interpretation of the findings of CAEP and a set of recommendations based on the findings. The work of interpreting the results presented earlier in this report was the responsibility of the CAEP Mathematics Advisory Committee. These recommendations, developed by the committee, are appropriate to several audiences including, but not limited to, teachers, local administrators, curriculum planners, and state-level decision-makers.

### The Context: The Committee's View of the Findings

The findings of CAEP were viewed by the committee as constituting baseline information about the basic mathematics skills and knowledge of Connecticut 9-, 13-, and 17-year-old students. The committee designed the tests to include tasks that were within the experience of all students at each respective age/grade level. The tests, therefore, increased in difficulty for each successive age level. However, because the overall test score was approximately the same (74-77% correct) at all three age levels, it was concluded that the tests were generally comparable in difficulty with respect to each age level.

Nevertheless, the tests were not seen as representing all of the skills that one would hope students would develop in the course of their schooling in the target grades. The committee, therefore, viewed the results of the testing as providing essential, descriptive information on a *set* of high-priority learning objectives.

Since only a small number of items represented each objective on the tests, the committee refrained from addressing issues of *mastery* of the objectives. Rather, they elected to imbed their interpretations and recommendations in the context of their professional *expectations* for students statewide in consideration of the particular group of items for each objective.

Frequently, the same test item was administered to more than one age group. This duplication of items across tests permits a comparison to determine the extent to which students of each age level differ in achievement. In such comparisons it is hoped that achievement increases as the age level increases. A decrease in achievement provides information useful for instructional planning, since it is one indication that a mathematics skill judged important by Connecticut educators is not uniformly retained or reinforced across the school years.

The committee, in establishing expectations for performance, was sensitive to the problem of retention of learning. It should be noted, for example, that some 17-year-olds have taken math courses in only one or two years of high school and, consequently, have been "away from" math for some time. Since retention may suffer under these circumstances, the committee's expectations were adjusted accordingly.

The committee made interpretive comments relative to performance which fell short of expectations, and to performance which met or exceeded expectations. While most recommendations are based on perceptions of weaknesses in student skills, the committee emphasized that strengths should not be overlooked. In particular, areas which showed high performance by students should continue to receive the same quality of curricular and instructional effort in order to maintain student strengths in these areas.

The substance of the interpretations and recommendations relates to the performance of Connecticut students on goal areas, objectives, and test items. The committee also made some recommendations on the basis of results comparing Connecticut students to students in the Northeast Region and on the basis of student questionnaire results. The report concludes with a set of broad-based, overarching recommendations.

# CHAPTER 6

## GOAL AREA: MATH CONCEPTS

### Discussion

Nine-year-olds performed relatively well on two of the three Math Concepts objectives (almost 80% correct on Place Value and Ordering of Whole Numbers), but, since the content of these objectives required only rote learning, the committee had hoped that 9-year-old performance would be in the 85-90% correct range. Performance on Objective 3 (Fractional Notation, 66% correct) tended to decrease 9-year-olds' overall score on the Math Concepts goal.

Performance on two items for Objective 2 (Ordering Whole Numbers) are worthy of note. One item (#58) was less rote than other "ordering" items, since students had to find a number 10 *more than* 4375. Only 59% of 9-year-olds answered correctly, and the committee was concerned, because the concepts of "less than" and "more than" are important, especially for estimating quotients in division. Another item (#10) required 9-year-olds to order a set of five-digit numbers which is a complex task for this age level. The committee was encouraged that 65% of 9-year-olds could perform this task correctly.

Of all objectives, 13-year-olds scored lowest on understanding and ordering rational numbers (Objective 1—62%, Objective 2—61%). While their performance on whole numbers and decimals was good (based on the limited number of items measuring these skills), they were much weaker on fractions. In fact, the scores on the objective "ordering" were most dramatically affected by the scores on those items involving ordering of fractions. They had particular difficulty with identifying the greatest fraction in a series and identifying a missing fraction in an ordered sequence.

The small increase in performance on Objectives 1 and 2 (Rational Numbers and Ordering) from the 13- to 17-year-old level was disappointing and did not meet expectations. This minimal growth reflects deficiencies in stress at the earlier levels. The committee did not suggest that these concepts be taught again at the high school level. Rather, they pointed out that, if not taught by age 13, these concepts are not likely to be taught at all. In general, eleventh-graders should have demonstrated a better understanding of fractions, because the practical use of fractions in everyday life requires an understanding on the part of the student. However, as did the 13-year-olds, they performed well on the items requiring an understanding of decimals.

Low performance by 13- and 17-year-olds on the item, "13 boys and 15 girls in a group, what fractional part is boys," highlights the fact that students have difficulty with the conceptual aspects of fractions. While this item was of a higher taxonomic level than the others, the task was in its simplest form and the skill is treated extensively in textbooks. Student performance on this task underscores their inadequate grasp of ratios, a topic which is part of the seventh- and eighth-grade curriculum. In general, they did worse on items requiring an *understanding* of fractions than they did on purely rote tasks with fractions.

## Recommendations

(1) Ordering and place value are closely related concepts and should be taught simultaneously. The emphasis on these concepts in the primary grades should continue, and more stress should be placed on the important concepts of "less than" and "more than."

(2) Fractional concepts should be introduced and taught in terms of things the young student already knows, with special stress on the concept of "wholeness." More use should be made of manipulatives to demonstrate the relationships of fractional parts of 1.

(3) Treatment used to develop fractional concepts in the first and second grades should be continued in the third and fourth grades. The emphasis should be on the fundamentals of the meaning of fractions and on real-life situations.

(4) Models of equivalent forms of fractions should be used as aids to teaching the ordering of fractions as early as the fifth and sixth grades, and extending into the seventh and eighth grades. In preparation, students in the third and fourth grades should be matching equivalent fractions. At *all* grade levels, fractional problems should have concrete models (e.g., folding paper, arranging marbles, geoboards, cardboard shapes).

(5) Basic skills should be viewed as including *understanding* the basic concepts and should not be restricted to purely rote exercises. According to the test scores, there is a great emphasis in the early grades on rote tasks and not enough emphasis on *understanding* of the concepts. At all levels, stress should be placed on the transition from rote skills to their applications.

(6) There should be more concentration on teaching the relationships between fractions and decimals. The practical applications of these concepts are important for all students whether or not they are college bound.

# CHAPTER 7

## GOAL AREA: COMPUTATION

### Discussion

*COMPUTATION WITH WHOLE NUMBERS.* Overall, 9-year-olds achieved very well on computation with whole numbers, scoring between 74% and 82% on all three objectives (Adding, Subtracting, and Multiplying). Achievement of the upper age groups was even higher than that of 9-year-olds, with scores in the high 80's and 90's on all items involving computation with whole numbers.*

Nine-year-olds also had difficulty with one item (1054 - 865 =) that required subtraction from a number with a zero in the hundreds place and required regrouping from thousands to tens. This task is actually not within the experience of all fourth-graders, but since it was a NAEP item, it was included for comparison purposes. However, while 9-year-olds had difficulty with the item, the committee was encouraged that a respectable percentage (51%) could answer it correctly.

Sixty-eight percent of the 9-year-olds could do the problem, 402 x 7, a respectable performance but lower than performance on other multiplication problems. Multiplication with a zero in one of the factors was not a problem at the upper grade levels (91% of the 13-year-olds and 95% of the 17-year-olds correctly answered 609 x 73).

The committee specifically addressed one other item (#22) for 9-year-olds, one that was really not well matched to the objective of Adding Whole Numbers, since it involved dollars and cents, therefore decimal notation. The committee again selected the item to permit comparisons with NAEP data, but also felt that money problems generally are and should be taught at this age level along with the addition of whole numbers. Interestingly, 48% of 9-year-olds answered the item correctly, and 27% added correctly but made a decimal error.

*COMPUTATION WITH DECIMALS, FRACTIONS, AND MIXED NUMBERS.* There was some improvement in achievement between the 13- and 17-year-old levels in Adding

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* With one exception, 714 ÷ 7, which required a zero in the answer. The common error of 12 points out the importance of estimating the reasonableness of an answer.

and Subtracting Decimals (81% correct for 13-year-olds and 90% for 17-year-olds on Objective 6). In fact, 17-year-olds performed exceptionally well, with 84% as the lowest percentage of students scoring correctly on any item for the objective. The item on which 13-year-olds had most difficulty and which reduced their objective score (23.8 subtracted from 62.1 =) was a harder item, since it was given in horizontal form and required renaming.

Performance was relatively lower (72-75% correct) on Objective 7 involving multiplying decimals (13- and 17-year-olds) and dividing decimals (addressed only at the 17-year-old level). As noted earlier for 9-year-olds, students at the upper age levels continue to have difficulty with correct placement of decimals. Decimal placement in multiplication is a problem at both upper grade levels (especially in decimal x decimal tasks) and extends to decimal division at the 17-year-old level.

Of all computation objectives, performance was poorest on Adding and Subtracting Fractions and Mixed Numbers (Objective 8). There was some improvement in performance between 13-year-olds (62% correct) and 17-year-olds (69% correct), but it was not educationally meaningful. Students appear to be having difficulty with finding lowest common denominators and understanding the relationships between the whole and its fractional parts. This is reflected, for example, in low performance (64%) on a task requiring renaming of a whole number as a fraction ($4\frac{1}{4} - 2\frac{1}{2} =$).

Thirteen- and 17-year-olds were more skilled in Multiplying Fractions and Mixed Numbers (Objective 9), in the 70-80% correct range for 13-year-olds and 80-85% correct range for 17-year-olds. Relatively speaking, they had more difficulty with multiplying fractions by fractions than with multiplying fractions by mixed numbers.

Only 17-year-olds were tested on division of fractions, and their performance on the two items which tested this skill brought down their overall score on Objective 8 (Multiplication and Division of Fractions).

Overall, in computing with fractions, students performed expectedly best in multiplication, worst in division, and in-between in addition and subtraction.

Recommendations

(1) More stress should be placed on working with problems which have zero as a digit, with special emphasis on addition and subtraction in the early grades and on multiplication and division in later grades.

(2) In the early grades, as soon as the student understands dollar and cent notation, such computation should be stressed along with

computation of whole numbers. Teachers should avail themselves of this opportunity to teach basic computation in a relevant context and as a basis for the introduction of decimals.

(3) More emphasis should be given to learning objectives relating to computation with decimals, with special stress on correct placement of the decimal point. This skill should be seen as critical given its relevance to life roles.

(4) Students at the eighth grade level should receive more concrete practice in computation with fractions and mixed numbers, with special attention to lowest common denominators and greatest common multiples. These students require additional drill and practice with manipulatives.

(5) Concepts and operations with fractions should also be stressed at the high school level through the use of concrete models in order to facilitate adequate concept development.

(6) More instructional emphasis should be placed on teaching students to understand the relationships between decimals and fractions.

(7) Additional emphasis should be given to estimating answers and determining reasonable solutions.

(8) While there was consistent growth in performance from the 13- to 17-year-old level in computation with fractions and mixed numbers, these skills should be greatly stressed in the eighth, ninth, and tenth grades so as to attain even greater growth.

(9) Whole number computation appears to be well learned prior to the 13-year-old level and well retained thereafter. Teachers should capitalize on the fact that the basic principles for computing with whole numbers apply also to computing with fractions and decimals.

# CHAPTER 8

## GOAL AREA: MEASUREMENT

### Discussion

*MONEY, TIME, AND LINEAR MEASURE.* Nine-year-olds performed very well on all three measurement objectives (75-95% correct). Several individual test items on which performance was relatively lower are worthy of note. On Objective 7 (Money), 9-year-olds had difficulty with the item, "how many dimes in a half-dollar?" (59% correct). The committee was not concerned about this lower percentage, since 9-year-olds are not familiar with the term "half-dollar" ("50-cent piece" is more common for this age group) and this is not a very common coin.

Neither was the committee concerned about the fact that only 59% of 9-year-olds could answer correctly Item #6 for Objective 6 (Time), since most are unaccustomed to standard notation for time beyond the half-hour (e.g., 7:55). Also, on this objective, the committee pointed out that many 9-year-olds may not have read Item #6 carefully. While 68% answered correctly, a full 19% answered "9:10," the time *shown* on the clock face, rather than "the time it was two hours ago" as instructed in the item.

On Objective 9 (Linear Measure), students had the most difficulty with the item on "*estimating* the height of a girl in the fourth grade" (68% correct as compared to 87-93% on other items for the objective). The committee noted that this task of estimating is more difficult than the other items for the objective and out of the category of rote application of knowledge.

*PERIMETER, AREA, AND VOLUME.* While 17-year-olds performed reasonably well on measurement (73-82% correct for the three Objectives 10-12), 13-year-olds did not perform quite as well and showed much more variable achievement across the individual test items.

On Objective 10 (Area and Perimeter), 13-year-olds did well (82% correct) when asked specifically to find the "perimeter" of a triangle (with all three sides labelled) but poorly when asked to find the fencing needed to enclose a rectangular garden (45% correct).

When a rectangle was pictured in terms of square units, 84% of the students could find the area. But, when the dimensions of the rectangle were given, only 56% could find the area.

On Objective 11 (U.S. Conversions), the large majority of 13-year-olds could convert inches to feet, and hours to minutes, but smaller majorities could convert quarts to gallons (76%) and ounces to pounds (58%).

On Objective 12 (Metric), 13-year-olds performed respectably well (68-85%), with lowest performance on identifying the least magnitude of a metric unit. The committee interprets this result as an unfamiliarity with prefixes for metric units.

In contrast to 13-year-olds, about three-quarters or more of 17-year-olds could answer all measurement items for all three objectives, with only one exception. The one problematic item (59% correct) involved calculating the perimeter of a rectangular garden (formula not given). Thirteen-year-olds also scored lowest on this item.

Recommendations

(1) Teachers should stress the importance of reading a problem thoroughly before attempting to answer questions in order that more accurate diagnosis of student skills can be obtained.

(2) Students should be provided with more relevant experiences that afford the opportunity to practice estimating measurements in practical contexts.

(3) More stress should be given to teaching area and perimeter in terms of both underlying concepts and computation.

(4) In the early grades, instruction should give more emphasis to the learning of common and practically relevant conversions within both the metric and U.S. systems.

(5) In general, students are performing adequately on metric exercises given the newly emerging stress on metric knowledge. Attainment of metric knowledge should be assessed again in the future to determine trends in performance.

# CHAPTER 9

## GOAL AREA: PROBLEM SOLVING/APPLICATIONS

### Discussion

The committee was well aware of the possible confounding effects of reading comprehension in measuring skill with word problems in math. But, in general, the committee was satisfied that the vocabulary used in the test items was appropriate to the respective age levels.

There were two objectives related to problem solving for each age group: Math Problems and Real World Problems. Performance on both objectives was relatively low at all age levels (54% and 55% correct for 9-year-olds, 63% and 71% for 13-year-olds, and 62% and 71% for 17-year-olds).

The performance of 9-year-olds on Objective 11 (Real World Problems) was lowered substantially by Item #12 (fencing needed around a rectangular garden). Only 8% of this population could answer this question, probably due in part to the fact that the task is not within the experience of all 9-year-olds. (It was noted earlier, however, that 13- and 17-year-olds did not do well on this item either, with scores of 45% and 57%, respectively.)

The performance of both 13- and 17-year-olds on Objective 14 (Math Problems) was lowered by the item involving the calculation of a percent (27% correct for 13-year-olds and 46% for 17-year-olds).

It should be noted that at all three age levels there was great variability in achievement across the individual test items, depending on the item content and the skills involved. Therefore, it is difficult to point to an individual item and examine a set of skills needed for its solution. The skills essential to successful problem solving are not unique to the question. Many suggest that the relevance of the problem has much to do with how well it is answered. Others observe that adults do better than 17-year-olds with problem solving, even if they have not received additional formal instruction. All of these factors contribute to the complexity of the analysis of these objectives, but none should be used to avoid the seriousness of the problem or the importance of the skill.

Given the results on achievement on the problem objectives, it was the opinion of the committee that students are not being provided with sufficient practice in handling practical, real-world problems.

Recommendations

(1) Mathematics teachers should work with teachers in other curriculum areas to help reinforce problem-solving skills.

(2) Techniques of problem solving should be stressed even for good readers, emphasizing how to attack and solve word problems. Teachers should stress the importance of looking for *key* words that will indicate the operation(s) needed to solve a problem, estimating reasonableness of an answer, and checking for accuracy of computation.

(3) Every effort should be made to keep the problems relevant to the experiences and needs of the students.

(4) Problem solving should be an integral part of all math activities, not simply an isolated topic. Basic skills and concepts should be integrated with problems that strengthen computational skills and give relevance to the material being studied.

# CHAPTER 10

## GOAL AREA: CHARTS AND GRAPHS

### Discussion

Seventeen-year-olds' performance was excellent on interpreting data from charts and graphs (Objective 13), with over 90% answering each of the four items correctly. The performance of 13-year-olds was almost as good (87-92% correct across the items administered to them).

Nine-year-olds did exceptionally well (about 95% answering correctly) on three of the five charts and graphs items (Objective 12). They had more difficulty with the two remaining items. On one of these items (#38), which 70% answered correctly, students equated "closest in size" with "nearest in position."

On Item #18, results were easier to interpret; only 38% of 9-year-olds were able to interpret a pictograph on which each symbol represented more than one unit.

### Recommendation

(1) Overall, the performance in this area was good. Teachers should continue to work with charts and graphs so as to insure continued success.

# CHAPTER 11

## GOAL AREA: GEOMETRY

### Discussion

Objective 13 (Geometry) for 13-year-olds dealt primarily with recognition of geometrical terms, and this age group appears to have a decent grasp of basic geometry vocabulary. They were strongest on the term "parallel" (94% answering correctly), weaker on "sphere" (83%), and weakest on "right angle" (71%) and "diameter" (74%).

For 17-year-olds, Objective 16 addressed knowledge of significant geometrical facts and geometrical problem solving. There was great variability in the types of items and in the scores. Over 70% of 17-year-olds knew the number of degrees in a right angle, about half could identify the size of the third angle given two angles in a triangle, and under 40% could estimate the circumference of a circle given the diameter or apply the Pythagorean theorum to determine the height of a pole.

Geometry knowledge and skills cannot definitely be said to be within the experience of all students. The specific geometric content common to the math background of all students was probably taught in grades 7 and 8. Certain basic relationships should be stressed to guarantee greater retention for all students, whether or not they elect to take a course in geometry.

### Recommendations

(1) While knowledge of geometry is not necessary to survival in adult life, such knowledge can certainly be useful in everyday life. Certain concepts and facts in geometry should be part of the high school math curriculum for all students whether or not they enroll in a geometry course per se.

(2) A study should be undertaken to determine those geometry concepts, facts, and skills most relevant in practical contexts in order that these may be built into the curriculum for all students.

# CHAPTER 12

## COMPARISONS WITH THE NATION

### Discussion

There were several differences in the research design of CAEP as compared with NAEP (e.g., CAEP used no audiotapes, and CAEP assessed age-eligible students only in the respective target grades). It was beyond the responsibilities of the committee to determine the effects of these differences on test scores. It is left to the reader to draw inferences with caution, bearing these differences in mind.

The reader is also cautioned not to infer causality from differences observed between the performance of Connecticut and national or Northeast students. The fact that Connecticut students surpassed other students, or failed to perform as well, does not necessarily mean that Connecticut schools are causing the difference in performance. Community characteristics, family background, and other personal characteristics of Connecticut students should be considered as bearing a possible relationship to performance results.

It was the opinion of the committee that the educationally meaningful comparison of Connecticut students is that with the Northeast region rather than with the nation, since the Northeast region traditionally scores higher than the nation as a whole.

The committee was encouraged that Connecticut 9-year-olds performed comparably with the Northeast on Math Concepts and well surpassed their Northeast counterparts on Computation, Applications, and Charts and Graphs. Connecticut 13-year-olds scored about the same on Computation, and above the Northeast on the other three goal areas (Concepts, Applications, and Geometry), but by a slimmer margin.

By contrast, Connecticut 17-year-olds performed slightly lower than the Northeast on Concepts, decidedly below on Geometry, about the same on Applications, and slightly above on Computation.

### Recommendations

(1) It is important to recognize that Connecticut students do not, as they get older, maintain their lead in achievement relative to Northeast

students. A study of this trend should be undertaken to determine the causative factors contributing to the trend.

(2) The comparisons for the goal of Geometry at the 17-year-old level reinforces the concern about the level of Connecticut students' skill in this area. Geometry skills and knowledge should definitely be included in any future statewide math assessment.

# CHAPTER 13

## STUDENT QUESTIONNAIRE VARIABLES AND ACHIEVEMENT

### Discussion

A number of questionnaire variables were shown in the results of the assessment to bear a relationship to mathematics achievement. Because cause-effect inferences were not justifiable on the basis of these results, the committee exercised particular caution in analyzing and interpreting them. In keeping with this concern, they made the following recommendations.

*SEX DIFFERENCES.* The mathematics scores of Connecticut boys tended to be higher than those of Connecticut girls, a trend that was more pronounced at the upper age levels. Seventeen-year-old boys scored higher than their female counterparts on a larger proportion of goal areas (five out of six) as compared to 13-year-old boys (four out of six) and 9-year-old boys (three out of five). Moreover, the margin of difference between boys and girls was widest at the 17-year-old level.

The committee expressed concern about these differences, noting the importance of mathematics as a life skill. It was their assumption that girls should be able to perform as well as boys in mathematics and that girls will need these skills as much as boys to maximize their opportunities in the job market.

*USEFULNESS OF MATHEMATICS.* Students who regard mathematics as more useful relative to other subjects they study tended to achieve higher mathematics scores than students who find it less useful. While this trend might just as easily be stated in another way (that is, students who do better in mathematics find it more useful), it was the opinion of the committee that student attitudes about mathematics should be given some attention.

*YEARS OF HIGH SCHOOL MATH.* Mathematics performance of 17-year-olds was substantially higher among students who had received more as opposed to fewer years of high school mathematics instruction. At the extremes, students who had taken three years of high school math scored over 25 percentage points higher on the total test than those who had taken none. It was the committee's feeling that high school mathematics courses can reinforce basic math skills and understanding encountered in earlier grades.

*HOME VARIABLES.* A number of home variables—parental interaction and encouragement, television watching, school aspirations, etc.—were shown to bear a relationship to achievement. But, since these relationships are confounded by other factors (such as socioeconomic status) and subject to various interpretations, the committee elected to make only one related recommendation.

Recommendations

(1) Local Education Agencies (LEAs) are encouraged to study sex differences in mathematics performance at the upper age levels in order to determine the causative factors contributing to these differences. Furthermore, if such differences are shown to exist, programs or services (such as counseling activities or in-service on the effects of student and teacher attitudes) can be developed in response.

(2) More focus should be given to orienting students to the relevancy and importance of mathematics, especially with respect to their lives outside of school. This orientation should be infused into classroom teaching and counseling activities and given equal stress among both boys and girls.

(3) High school students should be encouraged to take mathematics courses that serve to refresh basic skills and understanding in the interest of preparing for their roles as consumers, wage earners, and taxpayers.

(4) LEAs who are interested in the relationships between home variables and mathematics achievement are encouraged to study the interactive effect of these factors in their own communities.

# CHAPTER 14

## CONCLUSION

In analyzing and interpreting the results of CAEP, the Mathematics Advisory Committee attempted to restrict their recommendations to those that were justifiable on the basis of student achievement as defined by the CAEP tests. However, a number of priority concerns not necessarily keyed to specific data emerged in the course of their discussion. In the interest of highlighting these concerns, the following concluding recommendations were formulated:

<u>Recommendations</u>

(1) A state level mathematics coordinator should be assigned to:

(a) provide communities with consultative services as needed

(b) disseminate information on trends in mathematics curriculum and pedagogy

(c) institute a continuing process of in-service training in mathematics

(2) There is a need for in-service training of teachers on:

(a) test construction techniques (especially in connection with preparing word problems)

(b) interpretation of test results

(c) remediative and prescriptive techniques for developing students' mastery of basic skills

(d) the effect of teacher expectancies and attitudes on student achievement

(3) More interaction should occur between mathematics teachers and teachers of other subjects (for example, industrial arts, social studies, reading, physics) in order that they might work together to promote the development of mathematics skills. There should be, in effect, a more interdisciplinary approach to skills development.

(4) LEAs should be encouraged to develop an objective-based mathematics curriculum at all grade levels and to key the curriculum to appropriate criterion-referenced diagnostic and assessment materials.

(5) A statewide assessment in mathematics should be repeated three years hence in order to permit examination of trends in Connecticut students' mathematics performance.

These and the foregoing recommendations are intended to assist educators, administrators, and policy-makers in improving the quality of mathematics instruction in Connecticut. It is hoped that the findings presented here will encourage the reader to examine programs and services in his or her own educational environment.

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